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Creating A 21St - Century Learning Space

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CREATING A 21ST - CENTURY LEARNING SPACE

by

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To my wonderful third grader for letting see through their eyes.

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CHAPTER ONE

Introduction

Space matters. Research shows a clear correlation between the learning environment and students' outcomes (Barret, Davies, Zhang, Barret, 2015). Recent studies have examined the relationship between spaces, productivity and overall wellbeing, especially in workplaces. The sole purpose of the science of ergonomics, is to study the relationships between humans, objects, and spaces. This discipline aims to improve these interactions to achieve better results in different scenarios.

New educational trends advocate for more collaborative, engaging classrooms to fulfill the needs of 21st-century students. Educators have examined their craft, and curricula, and teacher preparation programs stress the importance of changing the 20th century mentality when the learning experience was teacher centered, and rote memorization was the norm. The 21st-century learning environment is student-centered. The teacher acts as a facilitator of hands-on activities. The students learn from each other, and have access to technology. They collaborate as feel part of a learning community. But even though this change of educational philosophy is widely accepted, implemented, and studied; classrooms still look as they did in the last century. Yet, very conclusive research links learning environments and outcomes. Surprisingly, most educators have never received any kind of formal instruction on the topic.

My interest in classroom design started with my first assignment as a teacher. I found myself with a blank canvas, and I immediately noticed everything was wrong about this space. I had the only classroom in the building with a window facing a brick wall. There were no white boards near the Smart Board, making difficult to write notes, or allow students to show their work. The only white board was in the back of the room, and the corkboards were too high on the walls. This place was not meant to be classroom; it used to be a computer lab, and it was good for that purpose, but to serve as a classroom, it needed a lot of work.

I worked on this classroom for two years, and we made it work as best as we could, but never felt completely right. In my third year, I moved to an actual classroom. The difference was noticeable. The long whiteboards on both sides of the Smart Board felt like a luxury. Each student had unobstructed views of the front of the classroom, and the space was flooded by natural light. Our window featured a beautiful bush that was visited often by cardinals, and make us feel closer to nature. It was a treat.

During that year, my district began to offer workshops on something they called: "Design for learning". They framed it as a new exciting possibility for transforming our learning spaces, promoting engagement and collaboration between students. This "new" idea was very appealing to me, given my design background. I attended two sessions facilitated by my colleagues, and learned about basic design principles that facilitate collaboration, idea sharing, and engagement: like group sitting, standing desks, active sitting, and dry erase paint for walls. Even though the topic was interesting and made sense to me, I did not feel I had enough research-based information to understand the

process of improving a learning space. My lack of knowledge actually made me want to dig deeper in the field of classroom design.

I started reading blogs, but these blogs quickly led me to research-based designing principles that gave a foundation to my empirical work. I had heard before about 21st-century learners, the skills they needed to succeed, the role of the teacher in the 21st-century classroom, but I had not heard to that point about 21st-century spaces, and how they have been a fundamental part of a 21st-century education. A 21st-century learning space, in short, provides different areas for different kinds of learning activities |one on one, group, and whole class instruction, promotes collaboration, it gives the students space for individual, reflective work while they are still part of a large group, and it feels more "home-like" to students, improving their sense of belonging.

Armed with this basic knowledge, I started thinking about my room, the furniture, and how students interacted with the space and with each other. With my students, I played with different seating arrangements. Some students chose not to have a desk at all, some requested standing desks, and some chose to work on a coffee table, sitting on pillows. It was a very enlightening process, and I learned that the students have very strong preferences for the furniture they use, and the spaces they like to work in. As a result of this "experiment" I saw more movement, more interactions, and more productive energy in classroom. My students became very aware of their bodies and how they felt more comfortable and ready to work. They learned how to use the space to fulfill some of their needs, and they felt comfortable enough to modify some of the furniture arrangements. They also gave me a lot of feedback during the process. I became more aware of the space, how my students were using it, which arrangements were not

working, and which spaces could be improved. More importantly, I adapted my teaching to the new dynamics of the classroom, and its overall higher level of energy.

Midway in this redesigning process, I got news that I had to move back to my old classroom. I panicked at first, but later realized that I had the opportunity of changing this "classroom," and transforming it into a real learning space. I got a lot of support from my media specialist and my principal. I was able to get rid of the enormous computer desks. They approved the relocation of my Smart Board, and the placement of new white boards. With these big "construction" projects are done, I had to figure out how to make this room work for my new set of students. What worked last year, might not work with a new class.

I learned from my casual approaches to the topic that students have strong preferences about space, and that each of them has different perceptions of comfort, and where is the best place to listen, to collaborate, and to focus. I enjoyed the natural collaboration that happens when students are sitting at a round table, versus what happens when they are using individual desks. Even when these are placed in clusters, students can easily withdraw to their "personal space," and they are less likely to share items and ideas. No to mention desks required the time-consuming task of desk cleaning each week.

After learning about 21st-century learning spaces, and implementing some of the design principles with my students, I started to think of my research question: "How to create 21st-century learning space?" I would like to learn how to change my classroom, based on research, and transform it into a 21st-century learning space. I would also like to observe if the students' behaviors and feelings correspond to what I have learned from

the literature. I would like to use this practical, first-hand knowledge to help me create a space that can be easily adapted to suit different classes, not just one.

There is a strong interest in classroom design and how improved learning spaces can affect in a positive way students' attitudes, engagement and collaboration. By rethinking the learning space, educators can support better the acquisition of 21st-century skills. The purpose of this capstone is to create a learning space that fit better the needs of 21st-century students, and use research to transform a traditional classroom, into a learning space that can be used as a teaching and learning tool.

In the next chapter I will examine the research done about this topic, and explain how these findings can lead to answers of my research questions.

CHAPTER TWO

Literature Review

Just ten years ago smartphones were in their infancy; social media was rudimentary at best; and we were lucky to have a couple of desktops in our classrooms. Technology is shaping the way we live. Our students are digital natives, and their relationship with technology is very different from ours. We often hear that we need to prepare our students to fulfill jobs that do not exist yet and to use technology we have not even heard of. However, in the United States many classrooms still look like they did many decades ago (Lippman 2010). Such 20th-century learning spaces do not support the type of learning experiences our 21st-century students need.

Some educators and architects have been focusing on how space has an impact on students, and how space can support the needs of the 21st-century learner. My interest in this body of research brought me to my research question: How can I create a 21st-century learning space?

In this chapter I will explore what the literature says about 21st-century student needs, how improved learning spaces can support 21st-century learners, how space impacts students and therefore the learning process, the L-shaped classroom as an alternative learning space that supports 21st-century learning needs, the role of educators as learning space designers, the history of educational spaces design in the United States, and the state of current school buildings in the United States.

21st-Century Learning Spaces

21st-century skills

Twenty-first-century learners have specific needs that educators need to address. According to *P21 partnership for 21st-century learning* (2007), besides mastering the curriculum, students also need a great number of skills to be successful in a digital and interconnected world (Content Knowledge and 21st-century Themes section, para. 2). Some of the skills mentioned include: Learning and innovation skills, described as "Creativity and Innovation, Critical Thinking and Problem Solving, Communication and Collaboration" (Learning and Innovation Skills section para. 1). Students also need necessary life skills such as "Flexibility & Adaptability, Initiative & Self Direction, Social & Cross-Cultural Skills, Productivity & Accountability, Leadership & Responsibility" (Life and Career Skills section, para. 9). The research suggests that in order to obtain such skills, educators need to change the way they teach, and learning spaces need to be transformed to fit these needs. (21st-century Support Systems section para. 1).

How space supports learning

Rigolon & Alloway (2011) refer to Loris Malaguzzi, the founder of the Reggio Emilia pre-school system. Malaguzzi depicts the learning space as a "third teacher," with the ability of communicate ideas, and concepts to the children, and can also stimulate them.

Nair and Fielding in Rigolon & Alloway (2011) point out that the school building and grounds can be considered a "three-dimensional textbook" (p. 64). From these

authors' descriptions of the space, one can understand the importance of the space in the children's development and education.

Brooks (2011) sees the 21st-century learning space as a place conducive to learning by promoting constructivism, active learning, pedagogical innovation, and increased student engagement. The 21st learning space is place where students are actively engaging in their own learning, working and negotiating meaning with each other, reflecting about their work, and learning from their peers; while the teacher is a guide and a facilitator. Instead of being instructed, students must be explorers who discover and probe new ideas and concepts (McLuhan in Bruce Mau Design, Cannon Design, & V.S Furniture, 2010).

Doorley & Witthoft (2011) define space as "the body language of an organization" (p. 38). If we see our buildings and districts as 21st-century organizations, these learning spaces should reflect our educational philosophies. In the 21st-century, schools are student-centered, where collaboration and problem solving skills are encouraged. Churchill (2014) describes this ideal 21st-century learning space, as a place where students are exposed to different kinds of learning experiences, like one-to-one, partner, small group, and independent work. Churchill also highlights the importance of providing space for project-based learning, integration of technology, and whole school experiences. In order to provide these experiences in a classroom, the space needs to be flexible.

McLuhan in Bruce Mau Design, et al. (2010) explains that a 21st-century learning space is a place that accommodates "periods of direction, guidance, research, sharing and summary. The furnishings should be flexible to support the dynamics and enhance the

opportunity for different types of learners to engage" (p. 8). The students should be able move through the classroom, move furniture and change the setting by themselves to suit their needs. The place should facilitate a student-centered, self-directed learning experience the 21st-century learner requires.

Churchill (2014) refers to Van Note's idea of a 21st-century classroom. Van Note stresses the importance of creating a space that supports small-group and whole-class work. This space should also allow movement and noise, integration of technology, and a place to display important concepts and students' work. Additionally, this learning environment includes a "spill over area" (p. 92) that allows students to work beyond their assigned classroom, and use other areas of the building for their work. Thus transforming the whole school into an integrated learning space.

Space has an impact in student learning

P. Barrett, Davies, Zhang & L. Barrett (2015) found in their research seven key design parameters, grouped in three design principles, that together make up for 16% of the variation in students' academic achievement. These are:

"Naturalness: light, sound, temperature, air quality and links to nature; Individualisation: ownership, flexibility and connection; Stimulation (appropriate level of): complexity and colour" (p. 2).

Naturalness, as defined by P. Barret et al. (2015), has been a subject of study for a number of years. The results indicate that light, sound, temperature and air quality can have a major impact on student performance. In fact, light, temperature and air quality count for almost half of the 16% of the variation on students' academic achievement mentioned above (P. Barret et al., 2015, p. 10).

Light. Wurtman in Tanner (2008) concluded that light is one the most important factors in controlling the body's functions after food and water (p. 11). Tanner complements this statement by pointing out the research by Ott which explains that full spectrum light is necessary for the synthesis of melatonin, which is critical for a child's development. Tanner suggests that classrooms without windows or that are poorly lit can cause adverse effects in health, like a daily form of jet-lag, or even small seizures in children and adults. Based on these negative effects on health, and Hughes' research, Tanner recommends that classrooms should have full spectrum lights instead of fluorescent or halogen ones. Full spectrum lights have the same effects in the body as natural sunlight (p. 11).

Tanner emphasizes the importance of having windows in classrooms. He refers to a study made by Heschong Mahone Group, which concluded that students with the most daylight in their classrooms made more progress in math and reading over a period of one year, compared with students in classrooms with the least amount of daylight. Tanner advocates for the use of large windows in learning environments, and explains that instead of being a distraction, "window gazing" is actually a relief for students. Tanner argues that for a student, it is easier to refocus on an activity after window gazing, than it is to refocus after engaging in activities that require more attention like drawing, or doodling. (p. 12). Tanner advises that skylights be installed in classrooms that lack of windows.

Dyck (2002) also highlights the importance of natural light on students' health. Dyck makes reference to a study that took place in Alberta, Canada which found that in a two-year period, students in an elementary school that used full spectrum lights "had 3.2

days less absences per year, nine times less tooth decay and grew three-quarter-inches more than students in classrooms with conventional lighting" (p. 9).

Temperature. Dyck (2002) also describes the effects of temperature on students' academic performance. He cites Harner, whose research suggests that the ideal temperature for reading comprehension is between 68 to 73.4 degrees Fahrenheit and that there is evidence of a reduction in reading speed and comprehension if the temperature is between 73.4 and 80.6 Fahrenheit (p. 9). According to Dyck, Harner's research found similar effects on math fluency. Students were better at performing mathematical operation when the temperature was between 68 and 74 Fahrenheit, thus concluding that an air temperature of 68 to 74 degrees Fahrenheit is ideal for most learning situations (p. 10).

Air quality. Bruce Mau Design, Cannon Design, & V.S Furniture (2010) mention that in nearly 15,000 schools in the United States, "the air is unfit to breathe" (p. 27). Old facilities with poor ventilation systems make the air unbreathable, and this has consequences on academic achievement. The P. Barrett, Davies, Zhang & L. Barrett (2015) research found that students have better academic development in rooms with "mechanical ventilation, large volume or large window openings." (p. 11).

Sound. Bruce Mau Design et al. (2010) mentions that high levels of background noise, which source is often cooling and heating systems, can have a negative effect on learning. This is especially true in young children, who require ideal conditions for hearing comprehension (p. 26). The authors also indicate that in many classrooms, listeners without any kind of hearing impediment can only understand 75% of the words read from a list (p. 27).

Dyck (2002) refers to Taylor's study, which found that "research on the effects of noise have not clearly demonstrated negative effects on learning over short periods of time" (p. 10). He acknowledges that noisy learning environments lead to "poorer auditory discrimination and less tolerance for frustration by children" (p. 10). Dyck recommends the use of sound absorbing materials (like carpets, and plush furniture) to improve the learning experience in such classrooms.

The Student as a User of a Learning Space

The space and the student's needs

In order to create the best possible 21st learning environment, the teacher-designer must understand the needs of the students, and accommodate the space to fit these needs. To explain this, Bruce Mau Design, Cannon Design, & V.S Furniture (2010) refer to Maslow's hierarchy of needs to explain the importance of an appropriate learning space from the student's perspective. Self-esteem and self-actualization only come after the basic needs have been fulfilled. The space must address physiological needs by offering appropriate shelter, access to food and water, and a comfortable temperature. Safety can be interpreted as an emotional and physical need. Sound facilities, clean air and water, safe furnishings, inviting hallways, well-lighted rooms, help the student feel safe, cared, and comfortable.

The space can also communicate that the student belongs to the learning space and the learning space belongs to the student. This space displays the student's work, interests and culture, the student is able to use and adapt the space to her individual needs. This learning place thus feels like home. More important, the student has fun in

this space. “If kids are having fun, they feel safe” (Design, B. M., & Furniture, V. S. 2010.p 199).

For this space to be student centered, the teacher-designer must consult the students and get feedback from them. Flutter and Rudduck (2000) in Bertram (2012), criticize the lack of voice for young people during the implementation of a project that is going to affect them. The researchers call this view “outdated” by ignoring the students’ capacity of express their opinions about issues that affect their lives.

The L-shaped classroom

Dyck (2008) found that the shape of the classroom has an impact on students’ levels of stress. Dyck explains how “crowding” is defined as “one awareness of others in a space” (p. 1), and suggests that square classrooms might increase this awareness of others. When children perceive crowding, they behave more aggressively and disengaged, which makes hard for students to learn in a crowded space (Moore & Lackney, in Rigolon & Alloway, 2011).

Dyck explains that asymmetric classrooms, and especially the L-shaped classroom (or a classroom which shape looks like a capital L), maximize the distance between students, decreasing the crowding effect.

Lippman (2004) has also studied the effect of L-shaped classrooms in student behavior, and argues that one advantage of the L-shaped environment over a conventional square shape classroom, is that the L-shape provides more corners for semi-contained working areas. According to Lippman these corners provide privacy and separation, reducing the crowding sensation. In these zones, students can be separate and part of the class at the same time. This allows different kinds of activities to occur at the

same time, without disruptions, supporting differentiated instruction and project-based learning.

According to Proshansky and Wolfe in Tanner (2008), privacy has been shown to contribute to a child's growth and development. Dudek in Rigolon & Alloway (2011) suggests that the sense of safety is enhanced by creating spaces for the children's dimensions, like niches or baskets. The L-shaped classroom provides more areas that offer a sense of "privacy" to students, besides the common areas where they can work and interact with each other.

The importance of furniture

Furniture and its layout also have an impact on how students behave. Doorley & Witthoft (2011) describe some of the effects of layout and furnishings on a learning environment. The authors suggest the use of vertical surfaces, like wall whiteboards instead of tables, to promote collaboration among the members of a group, and facilitate the display of work. They also insist in the importance of having writable surfaces everywhere. Doorley & Witthoft also explain how a reclined or seated posture is better for relaxed, and reflective work, but not very good for the generation of ideas. On the other hand, standing posture deals to active engagement. The authors recommend allowing a wide range of postures in the classroom to improve engagement, switching roles, moving from one activity to the other and generating ideas. Doorley & Witthoft emphasize that using flexible and movable furniture allows movement, and adapts from different types of activities. Another advantage of adaptable furniture is attention endurance. Bruce Mau Design, Cannon Design, & V.S Furniture (2010) describe that students that were given ergonomically ideal furniture (this is height adjustable desks,

and chairs, inclinable table tops, and chairs that rock, roll, and swivel), had far above average levels of concentration while taking tests.

Movement

Regarding movement, Breithecker in Bruce Mau Design, Cannon Design, & V.S Furniture (2010) argues that children sitting for long periods of time could develop sitting-related injury, postural damage and also problems with brain development. He advocates for school furniture that allows and absorbs movement, like dynamic sitting, and is adaptable to the body size of the student. Breithecker also describes fidgeting as natural response to mind and body fatigue, and even goes further by suggesting that after ten or fifteen minutes of sustained focus, students should be asked to stand in one foot or rock on a chair. Breithecker explains that by stimulating the balance system, the body releases neurotrophin, which is a hormone that has a great effect on brain activity (p. 83).

Breithecker proposes that schools should buy furniture that adapts to the students bodies, in the same way that companies buy furniture that adapts to the workers' bodies. This furniture should absorb movement, instead of restrict it. Breithecker concludes that "Movement is life, and life is movement!" (p. 85).

Educators and Design

Lack of preparation

Without a doubt, the current teacher preparation programs lack of sufficient instruction on the physical environment effects on students. Jones (2012) complains that only through specialized training like Montessori, Waldorf, or Reggio, can educators learn about the role of the environment on the education of a child. Jones mentions that new teachers rely on veteran teachers, books for first year teachers, building guidelines,

or the internet to set up their classrooms. Jones argues that this situation is far from ideal. Schools have different architecture, features and goals. If the teachers do not understand the complexities of the environment, and how to use a space to achieve an instructional goal, it would be very difficult to take advantage of an environment in its full potential (p. 267).

Tanner (2008) criticizes this lack of training, and claims that teachers have almost no formal training on understanding how learning spaces influence student achievement. Tanner reprobates the practice of pulling down blinds on classroom windows, to prevent daylight to enter in the classroom and to obstruct the views. As we mentioned before, Tanner agues tat sunlight or full-spectrum light, is critical for a child's development. Tanner blames this practice on an insufficient understanding of the topic.

Jones (2012) recommends providing teachers with programs and professional development that focus on the impact of space on students, and on environmental psychology. According to Jones, this preparation should not focus just on how to set up a physical space, but also on how to evaluate its efficacy and make changes according to specific challenges (p. 267).

Beliefs and philosophy

Jones (2012) states that "the background and personal and professional experiences of teachers contributed to their values and intentions in regards to the establishment of the physical environment of the classroom" (p. 266). As we have described before, a 21st-century classroom is student-centered, and teachers are encouraged to be guides, and facilitators. A teacher that is not comfortable in such roles,

will not take advantage of a 21st-century learning environment, and despise the mother layout and ergonomic furniture, students will remain as passive 20th-century learners.

Eisner in Jones (2012) affirms that before making recommendations or suggesting changes on a learning space, it is necessary to understand how teachers and classrooms work. Jones then suggests that the relationship between the educator and the environment must be studied before attempting to make a change. For Jones, the teacher's values and intentions are closely related with the desire to improve the educational environment. Therefore, educators must believe in the educational power of a 21st-century learning space, evaluate and reflect on their own practice, and understand how the elements of design can improve, support and enhance, the learning experience.

This does not end at the teacher level. Jones quotes Fraser to highlight the importance of improving the learning spaces. "The classroom environment is such a potent determinant of student outcomes that it should not be ignored by those wishing to improve the effectiveness of schools" (Fraser in Jones 2012, p. 265).

Bertram (2012) invites individual schools to evaluate their mission and goals, and how making changes in the space might support those goals. Schools must share their vision with the whole community and revise together how space is used, defined, and envisioned. For Bertram this reinvention of the space is as important as the curriculum, instruction, and assessment, and must be part of continuous discussion in school buildings (p. 45).

School Buildings in the Past in the United States

Lippman (2010) makes a very complete overview of the history of the design of schools buildings in the United States. Lippman begins describing the schools during the

colonial period, as places where the knowledge was transferred directly form the teacher to the student. Public education often took place at church or at home, and its main purpose was to teach the child a trade or a skill. Learning was repetition and memorization of the bible. The students spend just a couple hours at school, and their attendance depended on their work schedule. Only a few schools were built during this time. The buildings were often a one-room schoolhouse. The teacher sat at the front of the room on a platform, and the students' chairs and desks were bolted to the floor.

Lippman calls the next era of education the "Industrial period" (p. 76). This period starts with the industrial revolution, and it the main concept was efficiency. This concept influenced the design of factories and school building alike.

Students were trained to work in factories and the new office environment. Educational reformers like Barnard, Carter, and Mann advocated for the necessity of free public education to guaranty the economic success of the country. This movement resulted in the instauration of the common school.

Cities began to grow and with this the necessity of educating a large number of students. The Lancasterian model became a solution for educating a great number of people using minimal resources. One teacher taught a group of a couple hundred pupils, with the help of student monitors. The monitors were older students that taught the younger ones. The school building consisted of a room large enough to accommodate a group of a couple hundreds of students. With the teacher at the front of the room, long tables faced the front of the room, and side benches along the wall supported small-group instruction by the monitors.

By the mid nineteen century, schools were divided in grades to address the students' different level of skills. Many school building also included a gym for athletic activities. Drawing and music were incorporated to the curriculum. Education itself still consisted in repetition, and memorization exercises and most states were against the education of African American students.

According to Lippman the next period in the United States education is the "Progressive era" (1890-1945) (p. 78). During this period, John Dewey advocated for child-centered education and flexible spaces. Dewey and others believed that students were active in their learning process and would learn through peer interactions and by doing. In this setting, students would be working in teams and learning from each other. The teacher was a facilitator that guided the learning process.

During this period many schools were built, and the class sizes were reduced. Junior schools, and high schools emerged to fit the specific needs of the teenager population. Offices, playground and other areas were added to the school building. Many of these designs were standardized and easily reproduced in different areas. These buildings were designed in a way that could be expanded vertically or horizontally without affecting the original structure.

Tables and desks were not bolted to the floor anymore, but the teacher's desk was still in the front of the classroom, and the students sat in rows facing the front. Lippman argues that these new school buildings were just enhancements of the one-room schools. Students did not have choices nor could they control their environment. The learning was still passive.

Lippman argues that during the "Modern era" (1946-1979) (p. 84), there were very limited funds for building schools. As a consequence, the design focused on the infrastructure. Students and teachers were expected to adapt to the building, instead of the opposite. Nevertheless, there was a change in the way the environments were designed, resulting in scaled, flexible, and adaptable spaces that fit the changing pedagogy.

The "Postmodern era" (1981-2000) (p. 88) is described by Lippman as a period when public schools were criticized for being ineffective at teaching students of color, low income populations, and minorities. During this period, many charter and magnet schools appeared, and there was an increase in home schooling. According to Lippman, the user still had to adapt to the space, and even though classrooms were rearranged by teachers and students to facilitate learning, problem solving, and reflective thinking, teachers were not knowledgeable enough to understand how the space affected the learning process, and designers didn't understand what needed to happen in these spaces.

School Buildings Today in the United States

Jones (2012) observes that the majority of schools in the United States were built in the 1950's. The design of these schools reflects the goal of providing an education to a large number of students after WWII. Elva Rubio in Bruce Mau Design, Cannon Design, & V.S Furniture (2010) claims that cost was responsible for the poor design seen in school buildings from the 1960's and 1970's. The resources were limited and glass was expensive. On top of that, it was important to limit distractions, and conserve energy inside the buildings (p. 47). For Jones, these buildings do not fulfill 21st-century needs. Jones claims that even if such schools have been renovated, they have not been reconceptualized (p. 265).

Rigolon & Alloway (2011) agree with Jones' idea, and argue that even though environmental sciences are widely accepted, only a small amount of schools have considered environmental sciences when designing their spaces. Rigolon & Alloway deplore this lack of communication between architects and educators. They describe traditional schools buildings as "shoe-box classrooms along with corridors" (p. 64), and also make reference to Hertzberger's study, which claims that architects and designers can propose ideas based on their knowledge, but the change must come from educators and communities (p. 64).

DeGregori (2007) highlights the role of educators in the 20th-century as initiators of the discussion on the effects of the learning space on student achievement. DeGregori mentions Dewey as responsible for the philosophical and experimental contemporary discussion about space, which should continue to influence progressive educators and administrators to think about learning environments (p. 35).

CHAPTER THREE

Methods

The purpose of this chapter is to explain the methodology of my research project, provide justification for choosing case study, and my means of collecting qualitative data.

How to create 21st-century learning space? This is the question I am trying to answer with this capstone. After learning about what my school district calls "design for learning," I started wondering how I could create what research describes as an engaging 21st-century learning space, along with my own students, and how these changes could affect their behavior, interactions, and my instruction.

During my first years as a teacher, I tried to have the "nicest" classroom I could just as most teachers do. However, my focus was often aesthetic, and the function came later. During the Spring of 2016, my school district started to offer professional development, and even grants to improve our classrooms. This program was based on what they called "Design for learning," which was mostly centered on the principles described in the book *The third teacher* (2010) by McLuhan in Bruce Mau Design, Cannon Design, & V.S Furniture. That planted the design seed inside me, and I started learning on my own about classroom design, often guided by blogs, and online articles.

The purpose of this research is to create with my students the best possible 21st-century learning environment, to the best of my knowledge, ability, and capabilities,

record the process, and analyze how my students engage with this space and the behaviors the space elicits from them.

Setting

The research was conducted in a Spanish immersion, third grade classroom in a k-5 elementary school in the western suburbs of Minneapolis, Minnesota. The students spend most of their time in this classroom. I teach them the core courses in Spanish, and they also receive music and English instruction in this classroom with two other teachers.

The school has an enrolment of around 900 students. The demographics of the school are the following:

White 88%

Hispanic 4%

Asian or Asian/Pacific Islander 3%

Black 2%

Two or more races 2%

American Indian/Alaska Native 0%

Hawaiian Native/Pacific Islander 0%

Students participating in a free or reduced-price lunch program 6%

Participants

The twenty students enrolled in this class are third graders between ages eight and nine. Ten of them are females, and ten of them are males. Two students are identified as white and Asian, one as Hispanic, and seventeen as white. All the students in the classroom are native English speakers, and attend a full Spanish immersion program. None of these students receives accommodations through a 504 plan, or receives any

form of special education. Six students receive support for reading, and four students receive services for gifted and talented students.

The students arrive to the classroom at 8:30 a.m. and leave at 3:20 p.m. Subtracting the time for lunch and recess, and some of their special classes (P.E., Media, and Art) the students spend around 5 hours and 40 minutes in the same classroom during the school day.

The Classroom

The classroom was set up based on 21st-century design principles for learning spaces, using what was available to me at that time. At the beginning of the school year, the space featured five clusters of desks, where four students could sit together. Each table had storing units for supplies, and some active sitting stools. The five tables had unobstructed views of the Smart Board and the front of the classroom, where relevant information such as schedules, and student work was displayed. This classroom in particular has a mild L-shape form, which provides five corners that were set off as "reading nooks" with pillows and rugs, for students to have a semi-private space. This classroom also has the advantage of having two spillover areas; a small foyer which is shared with two offices, and beyond the foyer, a short entryway that opens to the main east wing hallway. These spillover areas serve as a separate work space, where students can work in small groups or individually when they need to.

At the back of the classroom, one window faces a brick courtyard. This window is our only source of natural light, and it is adjacent to our built-in storage space. Because of this, I placed the kidney shaped table by the window, along with plants, where the

students can read, relax, work with a small group of friends, or have small group instruction.

The back of the classroom features the main reading nook with a rug, a lamp with a full spectrum light, and surrounded by bookshelves. In between these two areas, I placed a coffee table under a canopy in the shape of a leaf, where students can sit, read, relax, or work with a small group of friends.

Finally, to the west side of the classroom, I placed a high rectangular table for the students that prefer to stand while working.

These different environments combined according to research, will provide flexibility for group, team and individual learning, along with a home-like feeling that will promote belonging to the learning community.

Procedure

I conducted a "basic qualitative study" as defined by Merriam (2009). Merriam describes a basic qualitative study as the tool that helps the researcher to understand "how people make sense of their lives and their experiences" (p. 23). Merriam explains that qualitative research studies occur when the researcher is looking for "insight, discovery, and interpretation" (p. 43).

Given the nature of my research, which doesn't seek to prove, but rather learn about the interactions of students with their learning space, I choose a case study to answer my research question. Merriam defines a case study as "an in-depth description and analysis of a bounded system" (p. 42), and makes reference to Yin (2008) who recommends the use of a case study when it is "impossible to separate the phenomenon's variables from their context" (p. 43). In this case, the bounded system will be my

classroom, and my analysis will be a deep study of my students' behaviors in this particular space, with an emphasis on how they use the space they inhabit during the school day. Therefore, it would be impossible to separate the phenomenon from the context.

Bromley (1986) says that a case study, allows researcher to "get as close to the subject of interest as they possibly can, partly by means of direct observation in natural settings, partly by their access to subjective factors (thoughts, feelings, and desires)" (p. 46). This definition is particularly important for my research, given the special interest I have in the students' perceptions and feelings about their learning environment.

Creswell (2014) recommends the use of multiple forms of data while performing a qualitative research. Creswell mentions observations, interviews, audiovisual material, and documents and reports as valid forms of data. Latter this data is reviewed by the researcher, and then organized in themes (p. 185). The data will be collected by different methods. I will use researcher-based data from direct observations, and the analysis of photographs, along with participants' generated data in the form of student interviews.

Merriam (2009) notes that observation take place in the space where "the phenomenon of interest naturally occurs" (p. 107). It is the best data-collecting technique when the researcher can be an eye-witness to an event, situation, or activity and "makes possible to record behavior as it is happening" (p. 119). I will be using a field log to record observations through the school day from December to February.

According to Lippman (2010) a researcher learning about a learning space, can gather data through close observation of the community, and often gets "immersed in the context and studies behavior as a participant observer" (p. 44). As the classroom teacher

of this learning community, participated in the activities performed in the classroom along with the students, and took notes, made observations, and took pictures while the students were immersed in their normal routines. I also made field observations from the participant point of view. As the classroom teacher was also subject of the space, and was be able to describe my own experience and feelings. I changed my role multiple times, from participant observer when I am teaching my class, to complete observer when my students are being taught by other teachers. This change of roles helped me to gather data in different ways and with this, generated more reliable assessments.

I also used photographs. Still photographs helped me to capture a moment in time, while students were engaged in self-directed work, or while working with other teacher. The analysis of the visual data included finding patterns on the students' use of the space. As defined by Merriam (2009): "The analysis of the data involves identifying recurring patterns that characterize the data. Findings are these recurring patterns or themes supported by the data from which they were derived" (p. 24). Photographs had a special meaning for my research, because they were not only generated by me, but also by my students. I used this type of data described by Creswell as "photo elicitation" (p. 193). This form of data was critical for my study, because I gained a deeper understanding of my students' feelings about the space, and how they perceived it.

As is defined by Patton in Merriam (2009), qualitative data is "direct quotations from people about their experiences, opinion, feelings and knowledge" that can be obtained by interviewing the subjects (p. 85). For this research, my observations were as important as my students' perceptions. Merriam mentions Harper who explains that "In all examples of photoelicitation research, the photograph loses its claim to objectivity.

Indeed, the power of the photo lies in its ability to unlock the subjectivity of those who see the image differently from the researcher" (p. 146). The subjectivity of the student-generated pictures provided me with a rich perspective on how my students perceive themselves, their learning environment, and what is the effect of this space on their academic, social, and emotional behavior. By learning about the students' perception of the space, I gained a deeper understanding of the impact of a 21st-century learning space on the culture of a learning community.

The following are some of the statements I will gave to my students before taking the pictures. These statements allowed me to analyze the learning environment from the student perspective, and compare their feelings and ideas with my observations.

- This is a good place for working.
- This is a good place for relaxing.
- This is a good place for reading.
- This is my place in my classroom.

These are examples of follow up questions:

- Where is the best place in the classroom for reading independently?
- Where is the best place in the classroom for working on math?
- Where is the best place in the classroom for listening to a presentation by a teacher, a parent or a friend?
- What is the best place is the classroom for working with a team?
- What is the best place in the classroom for working with a partner?
- What is the best place in the classroom for taking an exam?
- What is your favorite place in the classroom?

Data Analysis

For this research in particular, the data analysis was "inductive and deductive" (Creswell, 2014, p. 186). The information was organized in broad themes, and the complexity of these categories increased as they were being analyzed. Creswell recommends to organize the information in five to seven themes (p. 199).

The data from the field notes and photographs was compared with the participant-generated pictures in order to validate the accuracy of the findings.

Creswell (2014) suggests coding the data using three categories: expected topics (like the ones learned on the literature review), surprising topics (unexpected ones), and unusual and rare topics (but of interest for the research) (p. 199).

Finally the themes or categories helped me answer my research question: How do I create a 21st-century space? The findings helped me to understand better the role of space in education and the ways I can improve my students' learning experience through changes in their learning space.

This chapter described the participants of this research and the setting where the investigation took place. A case study was chosen as an appropriate approach for the investigation, and tools and data analysis strategies were described. The next chapter will describe the results of the investigation.

CHAPTER FOUR

Results

In chapter three I explained the way I planned to conduct my action research. The setting is my third-grade Spanish immersion classroom, in an elementary school located in a suburb west of Minneapolis, Minnesota. The research methods I am using in this study include a mix of field notes, photographs, student surveys, and photographs of the environment generated by the students. All these methods were chosen in order to understand the environmental and ergonomic needs of my students. How and where they move through the day, where they prefer to work and why, etc? By understanding how the students use the classroom space, we can adapt and modify the current environment. Thus, I will strive to answer my capstone question: How can I create a 21st-century learning space? In this chapter I will discuss the results of these methods.

For me this process started two years ago thanks to my district's initiative to improve the learning spaces. I learned to observe critically how my students interacted with the space, how they moved through the classroom, and what spaces they used depending on what they were doing. By understanding my students' needs, I also started to change my teaching practices. I moved from the front of the classroom, allowed more productive noise and movement, and grew more tolerant of a higher amount of controlled chaos. The biggest changes in my classroom were not big construction projects or exciting modern furniture, but my acceptance of my students' preferences and choices.

Classroom Areas

My current classroom is an 840-square feet space with an 85 square foot foyer that we share with two office spaces. The classroom has a Smart Board, and a white board on the south wall. The teacher's desk, a couple shelves and a reading corner are along the east wall. The north wall features a bookshelf, a small work area under a canopy in the shape of a leaf, and a closet with a "built-in". There is also a small window, more shelves, and a cubby by the east wall.

Students gather in front of the Smart Board on a carpet during whole-class instruction. They also use this carpet for independent reading, or partner work. The reading corner is also used for independent reading, and partner work. The small work area in the back of the classroom is a very flexible space. Students use it during reading time, partner and small group work. The built-in holds accessible math packages, the classroom fish, pencils and pencil sharpener, and the recycled papers station. It also has cabinets for storing classroom materials. Right in from of our window is the kidney table, which is often used for small group instruction, partner work, and test taking. In the middle of the classroom are the round tables, which are the students' "home bases". They do most of their writing, and small group work on these tables. They also store their materials by these tables.

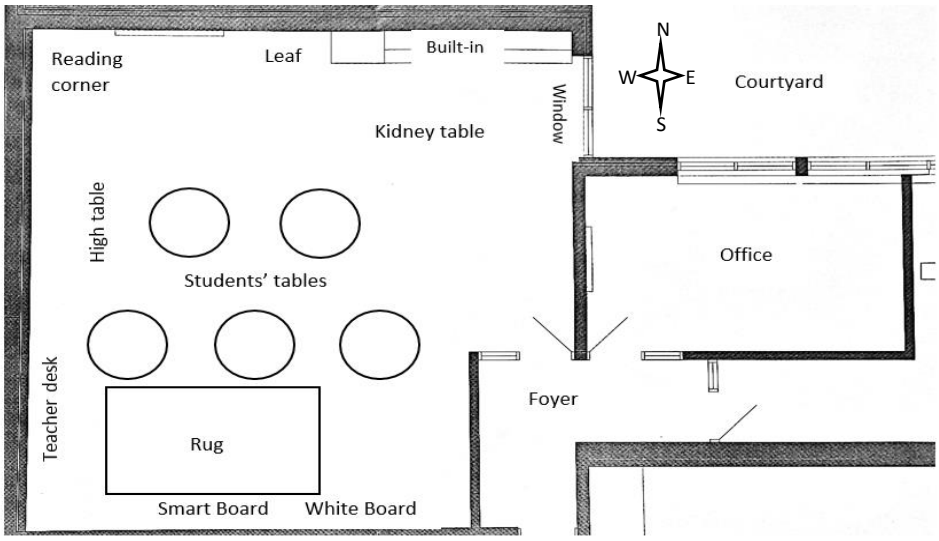
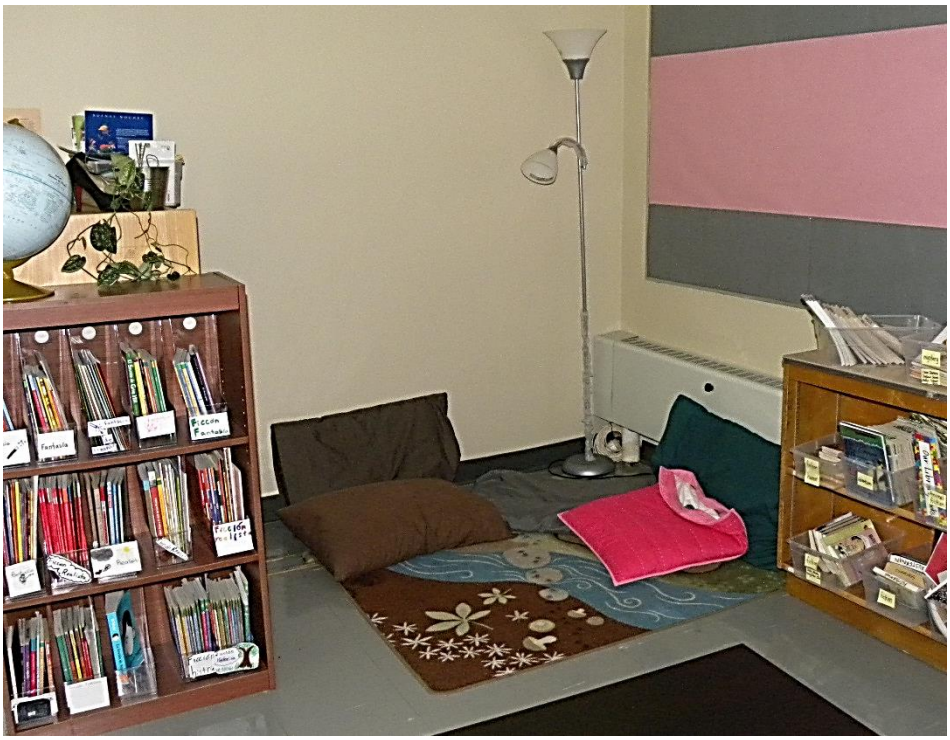


Figure 1: Classroom drawing

Picture 1: General classroom view



Picture 2: North West corner, Reading corner

Picture 3: North East corner, window, built in, and kidney table

Picture 4: Closet and "Leaf" work area

Picture 5: High table

Picture 6: Foyer

Picture 7: South East corner, rug, Smart Board, and Whiteboard

Picture 8: South West corner, teacher area, reading nook

I was interested on my students' interactions with this particular classroom set up. My first step was taking notes during the day, recording their behavior, and interactions.

Observations

Myself as a teacher

At the beginning of the school year I decided to focus on my practice. I recorded my feelings, and my own interactions with the space, and how that shaped my students' own interactions with their environment.

I set up the classroom thinking about the interactions I wanted to elicit. I had a clear idea of how I wanted my students to sit in groups, and share their materials. I also wanted them to have other areas for working besides their tables.

The first inconvenience I experienced was that the round tables I ordered did not arrive for the first day of school. Actually, they arrived in late October. I formed four clusters of four desks, and one cluster with five desks to accommodate my twenty-one students. These clusters occupied more space than the tables, and forced the students to face in one direction. I often felt trapped at the front of the classroom, without much room to circulate and reach my students.

The first weeks of school, we spent our time getting to know each other, and discovering the classroom and its possibilities. I allowed my students to explore the different areas, and test them. Together we talked about the best use for these areas. Once the rules of the classroom were created, I started giving my students more freedom to choose a place to work. I had the opportunity of observing for the first time how they were using the space, and their preferences. During these first couple of weeks, I felt a couple of times that my students were making "poor choices." They sat with their best friends, talked more than they worked, wanted to play and have fun…etc. When I gave up control, they behaved like eight and nine year olds. Even though this was a big change for me, and I felt more than once out of my comfort zone, I learned about their stamina, social needs, and individual personalities. These explorations also helped my students to identify their favorite spaces in the classroom, and how some spaces were better than others for certain activities. They also learned about their own behavior, and started the process of evaluating their actions, being reflective, and thinking about better choices.

The students and the space

The first time the students were able to choose a place to work by themselves was during independent reading. They were free to read anywhere they wanted in the

classroom, using their best judgment. The students quickly moved to the corners, where I had placed pillows. Some of them used the coffee tables as reading benches. All my students tried to make themselves as comfortable as they could during reading time. None of my students used the kidney-shaped table during reading time. I intended the kidney-shaped table to be a small group work place, but I thought some students would like to use this space for reading as well.

Testing time arrived. The students are tested at the beginning of the school year in math and reading. They used an online testing system for this task. Thus, they had to use laptops for this purpose. Moreover, they could take these tests anywhere in the classroom. I asked my students to move anywhere they wanted for taking the math test. Half of the students decided to stay at their desks, and half of the students moved to different areas. Four of them picked the kidney-shaped table, three of them moved to the round table in the back of the classroom, and four wanted to work on the coffee tables. I intervened when they could not decide who should move to another place, given the lack of room. For the second part of the test, more students work at their own tables.

During reading time most of my students consistently picked a space on the floor, either a reading corner, the rug, or under a table. Almost each day, I found the students picking a different spot, but always making sure they had a pillow to sit on or hug.
At the beginning of the school year, math was the most static of all classes. The students often decided to stay on their desks, and work quietly by themselves. It took several weeks for them to get comfortable enough to move to different spots during math, and to work with their friends.

All these interactions made me realize that just like me, my students were testing the space, and learning from their own experiences which areas where more suitable for certain activities. They did not have a clear idea of what they wanted, and needed to experience an area before deciding if they liked it or not. It took us some negotiating and whole-class discussions to learn about the possibilities of the space we had, and which rules we needed to have to use these spaces effectively. We agreed that the most important rule was to pick a space that allows all of us to work the best we can. The direct consequence of not following this rule was to pick a new spot and try again.

As the school year progressed, and the students and I learned our new routine, the use of the classroom also changed. The students defined the areas of the classroom they liked the most for different activities, and collaboration happened organically without much intervention on my part. I used the rule we established to redirect some behaviors, and the students understood the reason why they needed to find a better place to work. Once we established good behaviors, I started to take pictures of them.

Photographs and Surveys

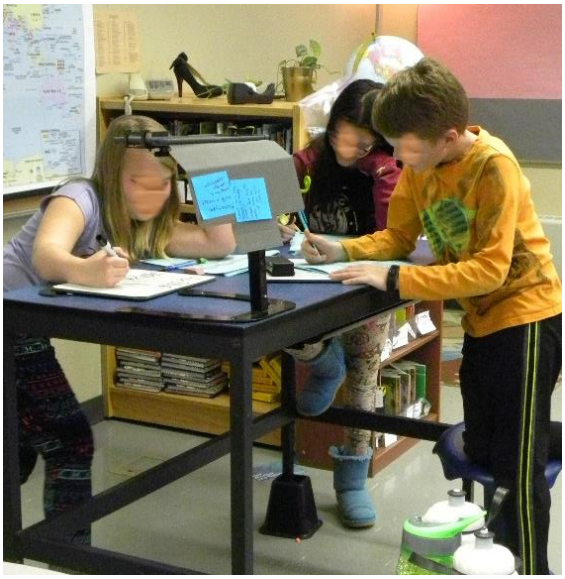
I started taking pictures of my students in December 2016, as a form of collecting data to support my notes. As I snapped pictures through the day, I began to notice some patterns. I found that my students move a lot. Even when they are engaged, and focused, they stand, and they rock their chairs, or sit on their knees, and sometimes, they even fall from their chairs trying to create movement and change positions.

Picture 9

Picture 10

They also move from place to place through the day. They choose different areas in the classroom according to the activity they are doing.

Picture 11



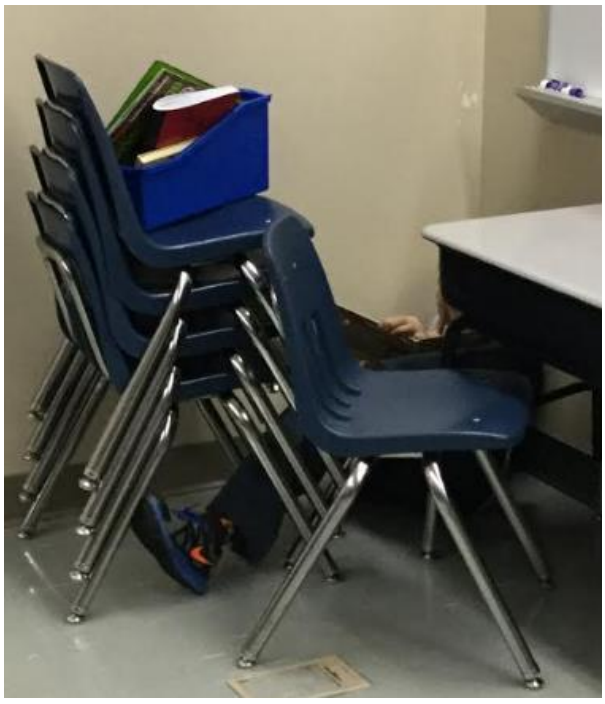
Picture 12

Picture 13

Picture 14

For their independent reading, or quiet work, some students prefer spaces where they can be by themselves.

Picture 15



Picture 16

In order to learn more about my students' needs, and confirm my assumptions based on the photographs, I created five different surveys. In the first survey, I asked them what they thought about ten different learning spaces. I chose pictures portraying diverse environments, from the traditional-looking classroom, to modern and minimalist spaces. I asked them to rank the pictures from 1 to 9, 1 being their least favorite, and 9 their favorite. To get a better understanding of their thinking, I added a field where they wrote down their thoughts about each space.

This survey was computer based. Some students had issues ranking the pictures, and just picked any number that was available at the end. After noticing this, I disregarded the number they gave to each space, and focused just on their comments. I divided the results between positive, negative and mixed comments.

The students had very strong opinions regarding pictures B, D, G, J, and K. (See chart on the following pages). Picture B shows a space common to our school building, and many other classrooms. This is the rug where students often sit to receive instruction. Fourteen of the seventeen students surveyed had negative comments regarding this space. They mention that the space felt crowded, childlike, or just uncomfortable to sit on.

Picture K had only negative comments. All the students surveyed disliked this space. The biggest reason they gave was the lack of chairs, and how uncomfortable it would be to stand the whole day. On the opposite side was picture J, with all the surveyed students giving positive comments to it. The students where very excited about this space, and kept talking about it in the following days. They liked the playfulness, coziness, and many uses of this loft. Picture D also had mostly positive comments, fourteen to be precise. Students described it as a great reading corner that looked comfortable and calm. The positive

reviews of the picture G were very surprising for me. I picked a picture of a Waldorf classroom, given how different this space is from my own room. The space is simple, all the desks are perfectly aligned in rows, and the wood makes it look like an old prairie school. Unexpectedly for me, many of my students liked this space. They mentioned the natural light, and big windows as the best characteristics of this space. One student even said she preferred the desks over the tables.

The positive comments often praised spaces with abundant sunlight, big windows, wood, bright colors and a warm feeling. They also preferred the pictures featuring interesting individual comfortable spaces like reading nooks, where they could read, relax, and retreat when they needed to. Furniture was another important element for them. They voiced their preference for active sitting furniture, and sofas. In general, they felt more drawn to the spaces with abundant natural light. They liked open spaces more than full and crowded ones. They also preferred spaces with various kinds of sitting possibilities such as the loft with the sofa, and cozy enclosed places.

The pictures that got the most negative comments, B, I, and K, showed spaces that they described as uncomfortable, boring or crowd. These classrooms looked very busy, and had tight circulation areas.

After learning about the spaces they prefer, I wanted to get more details about their work habits. I asked them their preferences for standing, sitting, or sitting on the floor during the day, and also their opinion about the chairs we have in our classroom. Ten out of eighteen surveyed students like to sit "a lot," eleven like to stand "sometimes," and seven like to sit on the floor "sometimes." Even though the majority preferred to sit most of the time, they also like to be able to stand, or sit on the floor.

Favorite classroom survey

	A	B	C
			
Positive	9	2	9
Negative	4	14	4
Mixed	4	1	4

Table 1, part a

	D	F	G
			
Positive	14	11	13
Negative	0	3	1
Mixed	3	3	3

Table 1, part b

	H	I	J	K
				
Positive	10	4	19	0
Negative	3	9	0	16
Mixed	3	3	0	0

Table 1, part c

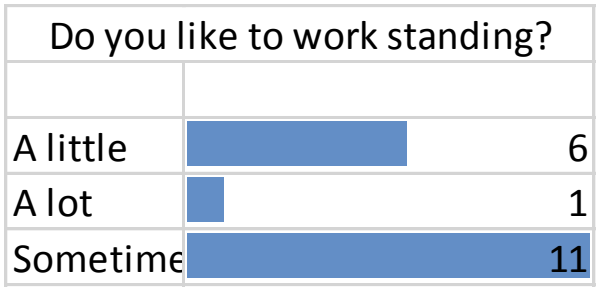


Table 2, part a

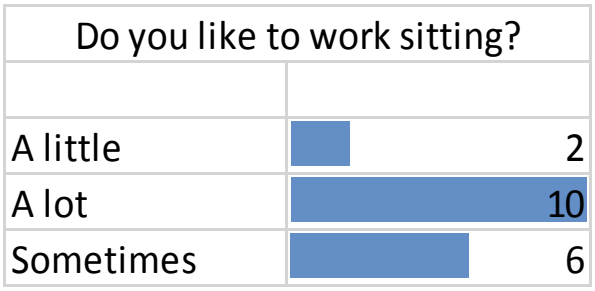


Table 2, part b

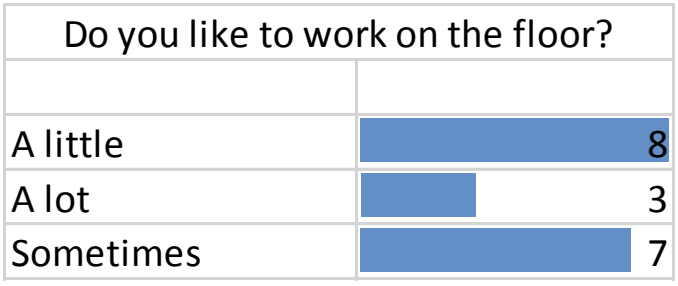


Table 2, part c

When the students took this survey, most of the chairs they had were the conventional stackable plastic chairs found in many classrooms. The classroom also had five active sitting stools [1] that the students rotate among themselves. When asked about type of chairs they would like to have in the classroom, they made very clear they wanted to have stability balls[2] in the classroom, and more active sitting stools. A couple classrooms in my building have been using stability balls instead of conventional chairs, thus my students' familiarity with these devices. The students also mentioned office chairs, sofas, and also low stools to use along with the coffee tables, beanbags, and bar

[1] An *active sitting stool* or chair, is a sitting device that allows the user to move constantly.

[2] A *stability ball* is a large, inflatable ball that is often used to exercise the back and the core of the body.

stools to use with the high table. Eighteen students said they would like to have active sitting chairs of different sorts.

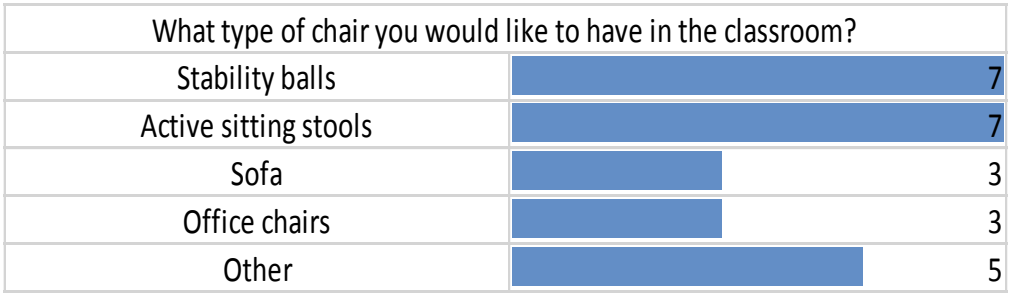


Table 2, part D

They also described improvements they would like to make in the classroom. Many of them have the vision of a living room-like area, with a sofa, coffee tables, and lamps. They also mentioned how they would like to improve the reading nooks, adding beanbags, pillows, blankets, and canopies. The recurrent theme for the improvements was comfort.

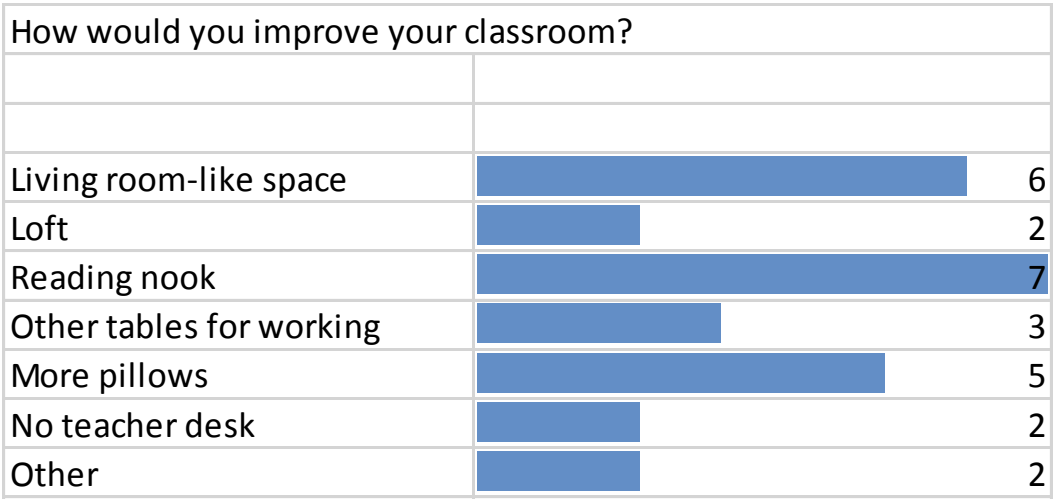


Table 2, part F

Given the overwhelming preference of my students for active sitting chairs, I decided to purchase five stability balls for the class. I also acquired five low stools, and three meditation pillows. My idea was to provide other sitting experiences for them, and later ask them what they thought about these sitting devices. I replaced two chairs from each table with one stability ball, and one low stool. Each day, the students rotated chairs, so each of them was able to experience the different sitting experiences. After a couple of weeks, I asked them what they thought about each chair.

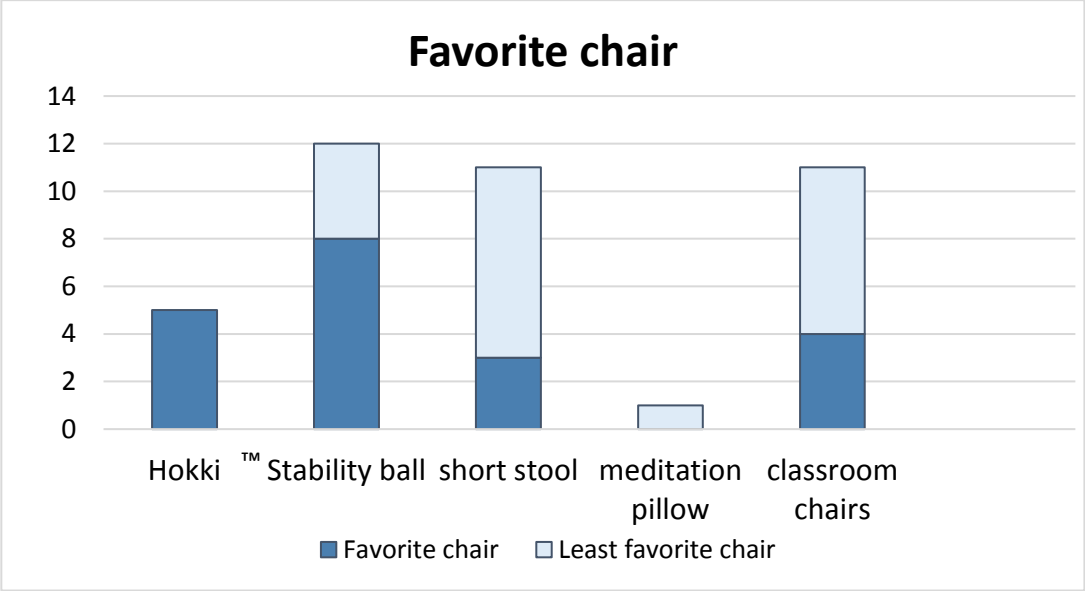


Table 3

The stability ball was the overall favorite. Students mentioned they like to bounce through the day and roll with this chair. Some students had negative comments about the stability balls. These were often related to how the stability balls do not stay in place, and roll through the classroom. I definitely have noticed the stability balls rolling around the classroom during the day. This problem can be easily resolved by purchasing bases that

limit the rolling, but still allow bouncing. Because of their volume, the balls also occupy a lot of space, and are hard to put away. Another big disadvantage I have noticed is that the particular stability balls I purchased for the class, deflate very fast. The students need to pump them up on a weekly basis. Despise these shortcomings, the stability balls are a students' favorites, and promote active movement during the day. The students bounce, and roll back and forth easily. Most of the time, the students use the stability balls when working at their tables, but they also take the balls to the rug for whole class instruction, or presentations.

Picture 17

Picture 18

Surprisingly for me, the active sitting stools were not as popular as the stability balls. Only five students said the active sitting stools were their favorite chairs. On the other hand, none of the students had negative comment regarding these chairs. The active sitting stools are very light, stable, and have a small footprint. They have a rounded base, which

allows the students to rock back and forth, and move from side to side. It is also very easy for the students to switch their focal points. They can be working at their tables, turn around to talk to a partner, or look in every direction of the classroom without a problem. The active sitting stools are easy to put away, and to move around the classroom. The students use them most of the times at their tables, but they also take them to the rug for presentations and whole class instruction, as they do with the stability balls.

Picture 19

Picture 20

The least favorite chairs were the low stools and the traditional classroom chairs. Regarding the short stools, students mentioned that they were too low on the ground, and that they were not comfortable to work with alongside their tables. Some students said the low stools were good for working on the coffee tables and on the classroom rug.

The traditional classroom chairs had a couple fans. They mentioned they like the back support that these chairs offer, and the fact that these chairs do not move. The detractors mentioned the lack of movement as a drawback for these chairs. In sum, most students preferred the chairs that allow movement. They also like other types of chairs for specific purposes.

After I learned about their work habits, their vision for the classroom, and the chairs they prefer, I wanted to know more about what the students thought about their current classroom. I gave them a handful of prompts. For each prompt they had to take a picture of a place in the classroom that they felt matched the description. With these surveys in particular I got to see through their own eyes. I learned that their favorite spaces are the reading corners, private spaces where they can be by themselves or with a partner, and their tables. In general, there was a great variety of answers, showing that each kid had his or her unique preferences and needs regarding the space they inhabit.

In my classroom, each student has two assigned spots. One is one specific place at a particular table, and a place on the rug. At the beginning of the school year I randomly placed the students on each table, trying to balance the number of boys and girls on each group. Every two months, I moved them to different places, always trying to keep the balance on each table, and minimizing possible conflicts, or distractions. These tables are the students' home bases, and their assigned work groups. The students share materials with the people at their tables, they also share jobs, and cleaning responsibilities.

The students in my classroom also have an assigned place on the rug. When I want them to go to "their place" on the rug, this means that they sit on their assigned number based on the classroom list (the rug has numbers from one to twenty around its edge.)

Usually they only sit on their assigned spot on the rug for morning meeting, and closing circle.

In the surveys, I noticed that many students have a strong preference for their tables. Tables were students' favorite place for relaxing and working alike. Eight out of seventeen surveyed students also identified their tables as "their place" in the classroom.

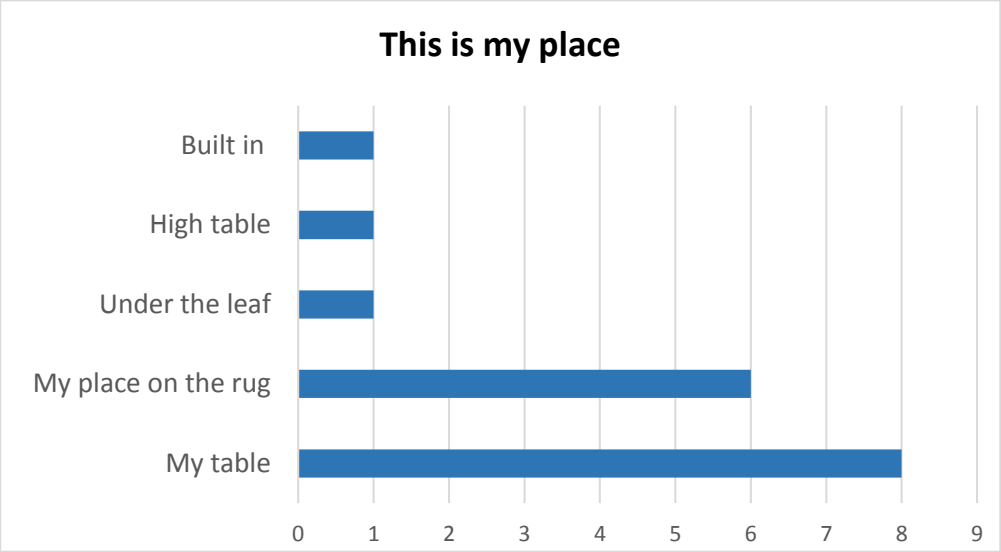


Table 3, part a

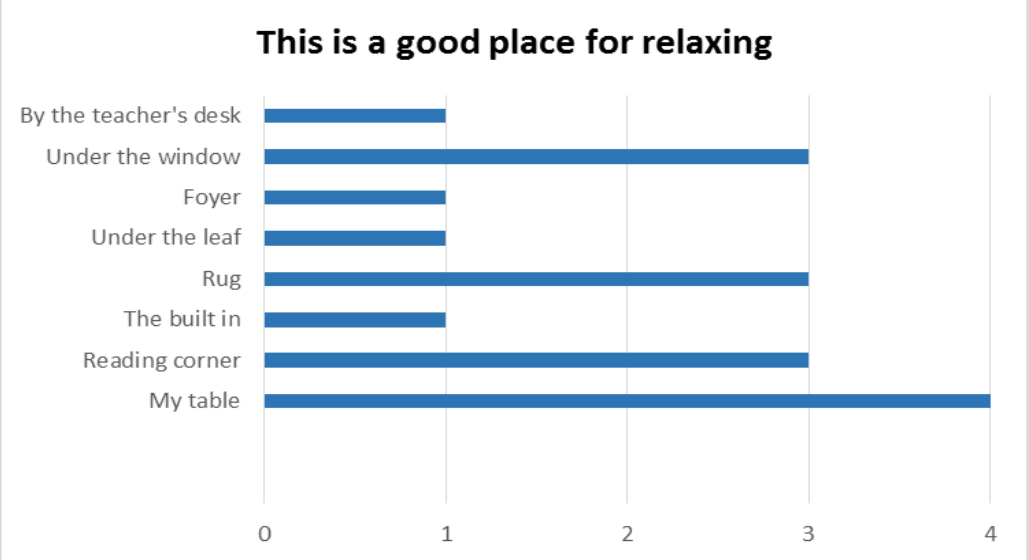


Table 3, part b

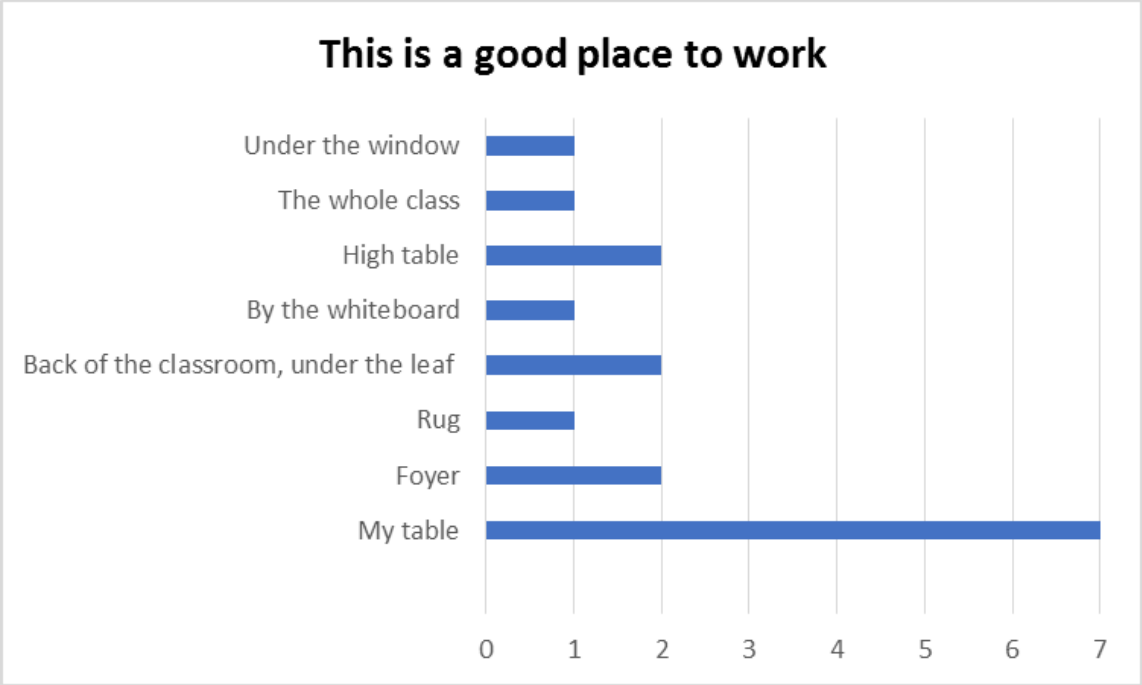


Table 3, part c

After analyzing this data, I came up with three conclusions:

1. Each student has unique ergonomic needs. Uniform chairs and tables are not suitable for twenty-one different growing bodies.
2. Students need to move, change positions, and go from place to place through the day. The classroom must have different areas to accommodate the students' needs. The classroom layout and its furniture must support the children's need for movement and comfort, and must adapt to the different activities the students do through the day.
3. My current students have a strong preference for warm, homelike, cozy paces, flooded with natural light, with interesting nooks and reading corners. They also prefer chairs that allow movement.

Findings in Relation with Literature

One of the purposes of this research was to gain a better understanding of my students' ergonomic needs and, with this, adapt my classroom to make it work better for my 21st-century learners. Breithecker (as quoted in Bruce Mau Design, Cannon Design, & V.S Furniture, 2010, p. 83) summarizes this findings in three words: "life is movement." Through field observations and analysis of photographs, I witnessed a wide range of movements my students perform during the day, and how their bodies try to find comfortable positions. Providing them with active sitting stools and stability balls helped them to move more during the day, and balance their bodies safely. As Breithecker suggests, students need furniture that absorbs the movement, instead of restricts it. My students confirmed this statement in the surveys, where they declared their preference for active sitting alternatives, stating they like to bounce and rock on them.

McLuhan in Bruce Mau Design, et al. (2010) explains that a 21st-century learning space is a place that accommodates "periods of direction, guidance, research, sharing and summary. The furnishings should be flexible to support the dynamics and enhance the opportunity for different types of learners to engage" (p. 8). Regarding the furnishings, it was interesting to see how the students adapted some furniture to their work. The kidney table was preferred by students that wanted to work as a team, and the two small coffee tables where used during individual or partner work. The two small tables move to different places in the classroom, according to where the students need them to be. They are either used to share and propose ideas with each other in a more intimate space, or they serve as barriers when the students need personal space for reflective or personal work.

During whole-class instruction time, some students preferred to sit on the carpet in front of the Smart Board, while others preferred to stay on their tables. A handful of students often brought chairs and stools to the carpet during instruction time. The chairs and stools helped them to sit comfortably when they did not want to sit on the floor. These behaviors are aligned with the idea of McLuhan in Bruce Mau Design, et al, that students should be able move through the classroom, move furniture and change the setting by themselves to suit their needs. Doorley & Witthoft (2012) recommend allowing a wide range of postures in the classroom to improve engagement, switching roles, moving from one activity to the other and generating ideas. Doorley & Witthoft (2012) emphasize that using flexible and movable furniture allows movement, and adapts to different types of activities. By providing movable and adaptable furniture, the learning space facilitates a student-centered, self-directed learning experience that fits 21st-century learners.

Switching from individual desks to round tables changed the dynamics of my classroom, and helped my students to collaborate more, negotiate their space, and share ideas and materials. But even though the round tables were a positive change, they are not ergonomically ideal furniture. As described in Bruce Mau Design, Cannon Design, & V.S Furniture (2010) the ideal furniture includes height adjustable desks and chairs, inclinable tabletops, and chairs that rock, roll, and swivel. My twenty-one students have very different sizes and body types. However, all of them are bounded for some time during the day to tables and chairs that cannot be adapted to their bodies. The best solution would be to have individual desks whose heights are easy to modify, and at the same time can be put together with other desks to form a cluster.

Regarding the classroom chairs, currently the active sitting stools, along with the stability balls, provide enough height variation to fit most bodies in the classroom, while allowing movement. However, they are still not perfectly ergonomic for the smallest or the tallest students in the class. The tallest students often have to hunch over to write or draw because the tables are too low for them. Conversely, the tables reach the chest of the smallest students, making them uncomfortable for work.

The surveys were a key component of my research. At the beginning of this process I had my own views of how the classroom should look, and what would be the best for my students' needs. Nevertheless, as Flutter and Rudduck (2000) say in Bertram (2012), for the space to be student-centered, the teacher-designer must consult the students and get feedback from them. By seeing through my students' eyes, and listening to their ideas and feedback, I began to understand what they need, and what they want in a learning space. Their ideas, overall, are aligned with what research on 21-st century classrooms has recommended.

In the "Preferred classroom" survey, I gave my students images of widely different learning spaces, from the standard white board and rug area, to the modern space with flexible sitting. I also added a picture of a Waldorf classroom. This picture portrays a classroom very different to my own. The natural elements are individual desks along with wooden chairs in organized rows. The walls are mostly bare, and two large windows flood the space with light and views of the outdoors. I thought the students were going to dislike the rows of desks, and the "low tech" aspect of this classroom. To my surprise, what a lot of them noticed about this classroom was the light. They praised the large windows, and the outside views of this classroom. Through this survey, many

students mentioned having a large amount of light on the classroom space was a positive characteristic.

My students' preference for spaces flooded with natural light, correlates with Wurtman's statement in Tanner (2008). Wurtman concludes that light, along with food and water, (p. 11) are the most important factors in controlling body's functions. Tanner mentions the research made by Ott which found that full spectrum light is critical for a child's development. Tanner suggests that poorly lit classrooms or those without windows can have negative effects on health. Tanner also explains that instead of being a distraction, "window gazing" is actually a relief for students. Tanner advises that skylights be installed in classrooms that lack of windows. Natural sources of light could be replaced by full spectrum lamps. Similarly, Dyck (2002) makes reference to a study in Alberta, Canada which found that in a two-year period, students in an elementary school that used full spectrum lights "had 3.2 days less absences per year, and nine times less tooth decay and grew three-quarter-inches more than students in classrooms with conventional lighting" (p. 9). In sum, full spectrum light is critical for human health, and especially important for child development.

Many of my students indicated the corners of the classrooms as their preferred space to do individual work. During my analysis of the classroom pictures, I also noticed that many students went to the corners for reading, working with a partner, or doing independent work. This finding confirms what I found in the literature review. Dyck (2008) suggests that square classrooms might increase the awareness of others or create a crowding effect. Dyck explains that asymmetric classrooms, and especially the L-shaped classroom maximizes the distance among students, decreasing the crowding effect.

Before I started this research, I had not realized that my classroom was, in fact, an L-shaped classroom. Through my previous years' experience in this space, I learned that the foyer had many advantages, like becoming an spill-over area for independent work, an enclosed area for making videos or rehearsing songs, and even as a waiting area for students that needed to take a break from the classroom. Through the surveys I learned that for some of my students, the foyer is one of the favorite spaces in our classroom. From my observations I discovered the many uses my students give to this space. Besides the obvious benefits of this foyer, the L-shape of the classroom features many other advantages over the traditional rectangular classroom.

Lippman (2004) argues that one advantage of the L-shaped environment over a conventional square shape is that the L-shape provides more corners for semi-contained working areas. According to Lippman, these corners provide privacy and separation, reducing the crowding sensation. In these zones, students can be separate and part of the class at the same time. This allows different kinds of activities to occur simultaneously, without disruptions, supporting differentiated instruction and project-based learning, activities that are essential on a 21st-century classroom.

Regarding privacy, Proshansky and Wolfe in Tanner (2008) argue that privacy has been shown to contribute to a child's growth and development. Dudek in Rigolon & Alloway (2011) suggests that the sense of safety is enhanced by creating spaces for the children's dimensions, like niches or baskets. Many of the corners in my classroom are bare. The students make use of them on a regular basis, but in the surveys they made very clear that they would like to see an improvement in this corners, transforming then into

more comfortable work areas. They mentioned the addition of sofas, pillows, beanbags and canopies as elements that could improve these corners.

In the pursuit of modifying my classroom, and adapting it to my 21st-century students. I asked the question: How can I create a 21st-century learning environment? Chapter four described what I found after observing my students' behaviors in relationship with the space, and my students' responses regarding their needs and preferences. Chapter four also explains the relation between the findings and research. Chapter five will explain the conclusion of this process and its results.

CHAPTER FIVE

Conclusions

The research question was, How can I create a 21st-century learning space? Chapter five will reflect on the following:

- Implications and limitations of the findings.
- Changes that could be made for further research.
- Summary

Implications and Limitations

Schools and classrooms must evolve and adapt to our 21st-century learners. Research describes the 21st-century learning environment as a place that is student-centered, and promotes collaboration and creativity, and allows students to develop problem-solving skills. It must also be integrated with technology. The space itself shapes these outcomes by adapting to different kinds of activities. This space has areas for whole-class instruction, group and partner work, small-group instruction, and individual work. Students should be able to adapt and manipulate the space according to their needs, and furniture should adapt to their bodies, and promote and allow movement. The 21st-century learning environment should also provide easy access to technology. The space must feel like home for the students. Adequate temperature, light, noise, and air quality are also crucial for the 21st-century learning space. Students need to be comfortable and safe before they can engage in learning.

Another important aspect in the creation of a 21st-century learning environment is student feedback. A student-centered space cannot be created or improved without the users' voices. Students, even at a young age, are capable of describing likes and dislikes, and can help the teacher-designer make decisions about their space, and evaluate prototypes or other proposed changes in the classroom.

My observations, along with the surveys, helped me to identify my students' particular needs, and how those needs match what research says about 21st-century classrooms. My objective then was to make changes in the learning space, making it more ergonomic, comfortable, and suitable for my students' needs.

From all these surveys I learned that the biggest problem of my classroom is the lack of definition of the different areas. The students have their group tables, the rug, the kidney table, and then, there is a collection of random items like coffee tables, and a couple of pillows they can move around. But the space itself feels very dry and uninviting. My students want a warmer, natural space, with more areas for individual work like nooks, lofts, or "caves." Comfort is a recurrent word my students used to describe an ideal classroom. The classroom currently supports group work, sharing, and community building; but definitely is lacking defined areas to use as personal space, where they can do individual and reflective work. These individual spaces are an essential part of a complete 21st-century classroom. My room's corners could be improved to enhance the home-like feeling of the classroom, providing real niches where the students can feel safe, comfortable, and can experience the benefits of having more privacy in their classroom.

In addition, through observations, and the surveys, I found that only one of my students prefers to stay the whole day on his table. All the other students mentioned different parts of the classroom where they like to work, during different types of activities. Providing a variety of spaces within the classroom will better support my students' needs.

Secondly, even though some kids really like the back support that the "old fashion" chairs give them, most of my students prefer to use different kinds of chairs through the day. They have a strong preference for chairs that allow movement, or that are suitable to use when they work on the floor, or with the coffee tables. They also prefer chairs that they can move around and take easily were they need them. They specifically mentioned stability balls, and active sitting stools as preferred types of chairs. Providing more active sitting options is currently one of my top priorities. Stability balls are my students' favorite, and they are a cheap alternative. However, a disadvantage of the stability balls is their low durability compared with other types of active sitting chairs. They are also quite bulky and difficult to put away or move around. A combination of different sizes of stability balls and active sitting stools could be a cost and quality effective way to provide my students with a variety of active sitting alternatives that also fit their different sizes.

Another big problem from my perspective is the limited access to technology. When the Smart Board was moved to the opposite wall of the classroom, the teacher desk ended up occupying the space formerly used by four desktops. The district requires that all central processing units (or CPU's) are connected to the network, but I did not have room for installing screens. The desktops became unusable. By having a big desk, I am

creating a big "teacher area" that has a large foot print and is taking the desktops' space. A 21st-century classroom must have easy access to technology, but instead, my room has big desk collecting dust and papers. I find it unnecessary. By removing the old teacher desk, and replacing it with a more compact option, I could minimize the teacher area in front of the classroom, and open up the space needed to install wall mounts for the computers. In this way, the students could have an easier access to technology, without depending on me booking the school's tablets or laptops.

This research helped me to discover that even though my classroom is a bit awkward, it has the great advantage of having a foyer. This spill-over area gives my students an alternative space to do individual work, and fulfils their need for privacy. There is a fantastic opportunity here to transform the foyer into a working extension of the classroom, with just the addition of a couple benches, or short stools, along with a coffee table.

The awkwardness of this classroom does not just end with the foyer we share with two office spaces. Our small window that faces a brick wall courtyard is probably our biggest barrier. The lack of natural light and exposure to outside views is a problem the students notice, and goes against the recommendations made by researchers. Ideally the courtyard we face could also become a very interesting spill-over area if we could manage to connect it to the classroom. A floor –to-ceiling door would provide us with more natural light, and we could end up with a safe outdoor area to use when the weather allows. A skylight could be installed, allowing even more natural light into the classroom, fulfilling the students' need for full spectrum light. The construction of either alternative, and the cost of these improvements make these changes unlikely, but the potential is

there. A more realistic alternative is changing all our fluorescent lamps to full spectrum lights, or the addition of more floor lamps with full spectrum light bulbs, to improve the lighting of the classroom.

During this research, it became very apparent that the one of the biggest limitations to creating a 21st-century learning space is funding. Even though my school district is incredibly supportive with this initiative, and actually has some funds allocated for making these changes, it is still hard to make all the improvement needed in one school year. With last year's funding I was able to move the Smart Board to the opposite wall, which helped to open up the space. I also replaced individual desks with round group tables, and also got five stability balls, five active sitting stools, and a three meditation pillows to use on the floor. Recently I was also able to obtain and test a wall mount for one desktop. With next year's funding I'm hoping to add a couple of benches and beanbags to create better reading corners. Also, I would like to add a "living room" at the back of my classroom as my students suggested, with soft furniture to complement our current coffee tables, and create an area for group planning and discussion. This furniture could also be moved around to provide comfortable spaces for individual work.

For many schools, such changes are not possible. Districts struggle to maintain buildings, let alone invest in specialized furniture, or expensive remodeling projects. But still, even though many teachers don't have access to these kind of funds, many changes can be made if teachers, administrators, students, and families understand the positive effects of improving the learning spaces, and make them more suitable for 21-st century learners. Teachers and administrators need to research the topic, embrace the change of

the classroom dynamics, explore creative alternatives, get feedback from students, experts and other members of the school community, and dive into classroom design.

Recently, more architects, designers, and educators have come together to think about learning spaces, and how these spaces can be improved. There are many educational blogs, and other sources that can help educators, and administrators to start conversations about their buildings, classroom spaces, and how these can enhance the learning experience for the students. In my case, The Third Teacher (Bruce Mau Design, Cannon Design, & V.S Furniture, 2010) was a great first read. This book from the beginning puts the user in the center of the conversation, and explains in a simple, but effective way how the space affects the learning experience, and considers the many elements that influence the design of a learning space.

Another valuable source for my research was Evidence-Based Design of Elementary and Secondary Schools (Lippman, 2010). This book is more academic. It includes current learning theories and how they apply to classroom design, offers a very interesting overview of the educational history in the United Sates, and how school buildings and classrooms have changed through the different eras. The book also includes case studies of buildings and classroom that were built to be the best physical environment for students to learn.

Both of these sources helped me to understand the importance of space for the students, what are the students' physical needs, and why it is important to reconceptualize our learning spaces to support 21st-century instruction.

As mentioned before, my school district is pushing forward the initiative of improving and reconceptualizing the learning spaces. Through this initiative I learned for

the first time about *The Third Teacher* and my interest on this topic was ignited. I hope to share with my colleagues and administrators the findings of my research, and also with my students and their parents. At my building I would like to briefly talk with my coworkers during one of our staff meetings, and open my classroom to anyone that would like to observe the changes I've made. Another way to share this research at a different level would be by collaborating with other teachers that have been promoting and mentoring the reconceptualization of the classrooms in our district.

Now that is almost the end of the school year, I would like to reach out to my students' parents and share with them the key finding of my research, with the intention of igniting in them an interest on this topic. When we reach out to the community we serve and show them what we are trying to accomplish to improve their children's education experience, we can create the best partnership, with the same goals. Parents can also be the changing force we need to bring change to our schools faster that we could do it by our own.

Changes that Could be Made for Further Research

Making changes in a classroom is a continuous process that requires ongoing experimentation, feedback, re-evaluation, and alterations. Judicious observations and student feedback are key during this process. At the beginning, I was not sure about what I needed to know from my students. Consequently, I ended up asking too many questions, what resulted in a very large amount of data that needed to be analyzed and processed.

For further research, I would ask specific questions to my students regarding particular areas of the classroom, or individual pieces of furniture that I am testing or interested on improving. I would also focus my observation specifically on those items.

I would also like to expand the scope of my research to the middle school and high school. It is very clear to me, as a third grade teacher, what are the physical, emotional, and intellectual needs of elementary school students. I understand how they feel about space, and how they navigate it. However, I do not have much information about the specific needs of middle and high school students. I would like to learn how my discoveries can be applied to them, and how their needs are similar or different from those of their younger counterparts

Summary

Our current students need to develop specific skills that prepare them for the challenges of the 21st-century. They need to learn relevant content, be creative, collaborative, and critical thinkers. They also need to make an effective use of media and technology, and lastly they need to be flexible, self-directed, productive, and responsible leaders. Schools need to support the development of these skills. Curricula and standards need to be reevaluated, and the physical space of the school and the classroom need to be conceptualized.

The classroom is not just the place that contains the students, but is a tool they use to develop skills, and enhance the learning process. Ideally, this learning space provides basic levels of comfort. It has large windows that deliver a good amount of natural light; the air quality is good; the temperature is comfortable, and there are not distracting noises.

This 21-st century learning environment needs to be student-centered, with a layout and furnishings that adapt to different kinds of instruction: whole class, small group, and one-on-one. This space also provides areas suitable for group work, partner work, and individual work. The furniture itself adapts to the students' growing bodies, and allows movement. The space itself must be designed with the users in mind. Student feedback is key for the success of the space.

To create a real 21st-century learning space requires not just a physical change, but more importantly, a philosophical change. The teacher needs to be part of the design process, and the space must be a reflection of the teacher's educational philosophy. The best furnished space won't improve the student experience if the teacher insists on dated practices, like expecting students to be quiet, immobile, and in the same place the whole day. The biggest change starts within the teacher.

Even though I have learned a lot with this research, I feel I am just starting to scratch the surface of this topic. The more I discover, the more I feel I need to learn. Each year a new group of students arrives in my classroom, and the space I am creating needs to adapt, and become their classroom. The space will change and morph all the time, and that is a great thing.

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