THE CLASSROOM ENVIRONMENT: THE SILENT CURRICULUM

A Senior Project submitted in partial fulfillment of the requirements for the Bachelor of Science
Degree in Child Development

by

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Spring Quarter 2011

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CHAPTER 1

INTRODUCTION

This senior project focused on the physical environment of elementary school

classrooms, with a particular emphasis on how environmental factors influence behavior and

academic achievement. Such environmental factors included lighting, color, acoustics,

temperature, seating arrangements, space and crowding, and living kinds such as plants and

animals. Previous research has demonstrated a connection between student behavior and the

classroom environment. Taylor and Vlastos (2009) developed a theory regarding the

relationship between environment and design within the classroom. They referred to the

physical environment of the classroom as the "silent curriculum" and hold strongly to the belief

that understanding the physical environment is essential to the education of children. The goal of

this project was to investigate empirical evidence on the importance of the physical environment

and develop a website in order to share this information with teachers and administrators.

Elementary school classrooms serve as the main context for learning and development

during childhood. As students of Child Development, we have spent the past 4 years learning

about the optimal way to facilitate learning by studying various theorists and their ideas on

children's development. We have encountered numerous theories on the way children gain

knowledge, but few that address the importance of the context through which that knowledge is

gained. We both share a passion for working with children and a belief that every child deserves

a quality education. Katie recently took an environmental psychology course at Cal Poly and

was fascinated by the environments power over human behavior. Brittany is an aspiring teacher

who is eager to learn how to set up her future classroom. Thus, we put our interests together and

decided to embark on this journey to discover exactly how to construct an optimal learning environment. The process of gathering evidence in support of our topic was a rather difficult one because much of the research found concerning the classroom environment was done in the 1970's when this issue was a hot topic. Additionally, up until the past two years, this topic has been virtually untouched by scholars within the fields of child development, architecture, and environmental psychology. Therefore, the research found in our literature review spans several decades, but still applies to the classroom today.

Regarding the spatial environment, we gathered research across the domains of space and furniture, seating arrangements, and density. The main findings concerning the spatial environment as a whole came from Reggio Emilia. She suggested that the optimal learning environment included plenty of space for classroom supplies, rearrangement of furniture, and designing spaces for both large and small-group activities. There are several different teaching styles and methods, but overall, a teachers' pedagogy must match the space of the environment.

The visual environment consists of lighting, color, and personal displays. These three components all have psychological effects on children that apply to the classroom. The general consensus found among researchers who have assessed lighting was that appropriate lighting improved academic results, reduced off-task behavior and played a significant role in students' achievement (Schneider, 2002, as cited in Spenser & Blades). Additionally, Sleeman and Rockwell (1981) addressed the psychological and behavioral effects of color on children. They found that colors could be perceived as warm, cool, stimulating, or relaxing. They also stated that color has the power to change moods, judgments, and behavior, thus validating the importance of assessing color in the classroom. Lastly, personal displays within the classroom were shown to have psychological effects on children as well. A study conducted in 2008 by

Maxwell and Chmielewski reported that personal displays have been known to increase student self-esteem.

On the topic of the acoustic environment, Shield and Dockrell (2003) concisely stated that poor classroom acoustics created a negative learning environment for students. Furthermore, Rivlin and Weinstein (1978) nicely organized the topic of noise into two categories: internal noise and external noise. It was discovered that when internal noise was superimposed with external noise, performance on classroom tasks drastically declined (Dockrell & Shield, 2004).

Three central findings were recorded regarding thermal environment within the context of a classroom. First, developing children have a different set of standards for their ideal thermal environment than adults. In addition, thermal induced stress could alter the learning and growth of children. Lastly, classroom temperature significantly affected children's problem solving abilities (Harmon, 1953).

The final environmental factor, living kinds, examined the impact that plants and animals had on children's achievement levels and behavior.   Plants were shown to increase feelings of comfort and friendliness within a classroom, as well as decrease mental fatigue and stress among children (Han, 2009). Animals were also shown to have positive psychological effects on children. For example, classroom harmony and communication increased while hyperactivity and aggression decreased when a dog was introduced into a classroom in Vienna (Kotrschal & Ortbauer, 2003).

In order to make this information available to practitioners, we created a website with the gathered information as a resource for educators to use and reference. The website consisted of 14 pages, with each environmental factor explored in its own page. The pages had a consistent

format that included information, pictures, and tips for improving the classroom. In order to evaluate our website, we had several teachers complete a survey that reflected their experiences and feelings after viewing our site. This provided us with feedback as well as ideas for creating a more effective resource, which was our main goal. Much of the feedback was helpful and aided us in making positive changes to our website.

It is our hope and desire that educators who view our project recognize the importance of re-evaluating the classroom environment. Our environments shape who we are, classrooms included. Children deserve an optimal learning environment and it is our responsibility as child advocates to provide this context of learning for them.

CHAPTER 2

REVIEW OF LITERATURE

Throughout their childhood, children will spend on average 30 hours per week in their

elementary school classroom. In a perfect world, the physical environment of a classroom would

promote learning, enhance academic achievement, and facilitate appropriate behavior in and

between students. The ways in which children perceive their surroundings greatly affects how

they will perform; therefore, it is imperative that instructors and administrators thoroughly

examine the physical environment of elementary school classrooms with an eye toward making

improvements that will benefit the teaching and learning therein.

Taylor and Vlastos (2009) considered the relationship between environment and design

within the classroom from a theoretical perspective. They referred to the physical environment

of the classroom as the "silent curriculum," meaning that the environmental design of a

classroom has the power to facilitate and enhance the learning process in ways similar to that of

the overt curriculum. As a result, Taylor and Vlastos argue that environmental knowing, or

reading environmental messages and acting responsibly, is fundamental to education. This claim

is informed by research across multiple academic disciplines (e.g., psychology, education,

architecture) that shed light on how the classroom environment affects student behavior,

achievement levels, and overall development. In particular, empirical evidence of the

relationship between such outcome measures and specific environmental features can be found

for perceptions of the environment, space and furniture, seating arrangements, density, light,

color, personal displays, acoustics, temperature, and living kinds. Careful consideration of each

of these elements can inform the renovation of existing classrooms, as well as the design of new learning spaces.

Student Perceptions of the Environment

The perceived environment can be just as important as the actual physical characteristics of a classroom. Classroom environments, as perceived by students, have a number of characteristics that influence student growth, development and achievement. LaRocque (2008) examined students' perceptions of their classroom environment, as well as the possible effect of these perceptions on academic achievement. LaRocque built her study on the notion that the most valuable information regarding the effectiveness of a classroom environment came from the students within that classroom. She asserted that students are in an excellent position to provide data about this environment because they are participants, capable of assessing information that an observer may miss or consider unimportant (LaRocque, 2008). To conduct her study, over 17,000 students between third and sixth grade were surveyed using the My Class Inventory. This survey measured students' feelings regarding cohesion, friction, satisfaction, difficulty, and competitiveness within the classroom. Results of this study uncovered a large range of information. To begin, it was found that students consistently felt less satisfied with their classroom environment as they moved up in grade level. Secondly, findings regarding difficulty within the classroom revealed that fourth graders were most likely to report a difficult classroom environment. LaRocque discussed how this is often referred to as the fourth grade slump; a phenomenon following the transition from lower elementary school to higher elementary school in which students experience difficulty with academic material as well as social interactions. Lastly, when students perceive their environment as more difficult, their academic achievement is lower. These results do not imply causation, rather they display a correlation between the

perceived difficulty in a classroom and achievement scores.   This all goes to show that children are aware of their classroom environment even if they do not understand the implications of the environment on learning. Evaluating student perceptions gives psychologists and researchers enough reason to investigate this topic of environmental design further.

Spatial Environment

One aspect of the teacher's silent curriculum is how the space of the classroom is presented to students and how the space is arranged. The spatial environment includes space and furniture, seating arrangements, and density within the classroom. All elements play a vital role in effecting student's learning. Past studies on the psychological and behavioral effects of the spatial environment have mainly been within the realm of office and workspaces. Presented below is research regarding the affects of educational spaces on children's achievement and behavior.

Space and Furniture. The space and furniture of the classroom often reflect teachers' differing ideas on the optimal way to learn. Taylor (2009) believed, "Just as different learning goals require different learning strategies, different instructional strategies require different learning spaces" (p. 134). Traditional instructional practices of the teacher lecturing to rows of students is passé and inconsistent with emerging understandings of learning. Researchers have collaborated and developed differing educational philosophies on the optimal way to learn and stressed the importance of how space is utilized in the classroom. Today the environment must match the teachers' pedagogy for the students.

Two highly regarded philosophers, Caine and Caine (1991) believe the old "assembly line" model to learning no longer supported findings about how the brain and mind processed information. According to their research, the brain has different avenues to acquire diverse areas

of knowledge (i.e. rote memorization for surface knowledge, problem solving for intellectual understanding and technical/scholastic knowledge; and learning from experience that produces a "feel" for things and results in performance knowledge) ("Caine Learning Center"). They discussed how this type of problem solving and experience-based knowledge required a flexible learning space. Today, many teachers are turning to project-based and teamwork as effective learning strategies. The space in the classroom must be designed to foster and support this type of learning. The arrangement of furniture must reflect the educational practices of our time. Learning environments consistent with this philosophy of education would have furniture not facing the front of the classroom, but geared toward group projects, cooperation, and new technology. The furniture would also have wheels, be collapsible, and stackable so that the space becomes more movable and flexible (Taylor, 2009).

Another philosophy on learning is Montessori. The Montessori philosophy emphasized the space and furnishings as an important factor in a child's education. Lillard (2005) explained Montessori's ideas on space: "The underlying structure and order of the universe must be reflected in the classroom if the child is to internalize it, and thus build his own mental order and intelligence" (p. 53). Spatial order is a basic human need. Children like order and enjoy putting furniture back to its designated place. The space and objects in the classroom need to be organized to help children's ideas of conceptual order and foster engagement with learning materials. Montessori classrooms also incorporate large open floor spaces to create movement in the space and reduce disruptive behaviors.

Complementing the Montessori philosophy, are the ideas articulated by the famous educational philosopher, Reggio Emilia, in which she supported the idea that the classroom is the "third teacher" ("About the Reggio Emilia Approach", 2011). According to this view, the

environment is not merely a space but a living and changing system. Emilia's philosophy supported the importance of learning opportunities and experiences. Elements of a classroom inspired by Reggio Emilia included plenty of space for classroom supplies, rearranging the furniture to draw attention to the environment, and designing spaces for both large and small-group activities. The environment constantly changes like a living organism to adjust to the current tool that is needed to inform and engage the learner.

The design and arrangement of space and furniture are factors in supporting the educational goals of the teacher and the students (Gump, 1987). The physical space of a learning environment communicates to the students a message from the teacher of what is to be expected in that environment. Each of the different philosophies mentioned above took careful consideration in addressing how the space in the classroom should be arranged. If the arrangement of space is unplanned and ineffective, unexpected conflicts can arise. Disruptive behaviors in the classroom can occur as a result of how the room is arranged (Proshansky & Wolfe, 1975). Loughlin and Suina (1982) developed a study comparing the communication behavior of the students in classrooms with clear pathways versus classrooms with unclear pathways. They found that by rearranging furniture and creating new pathways in the classroom, students demonstrated changes in their behaviors. For example, they found that establishing fluid traffic patterns in the classroom provided students with a better means of communication, but when traffic patterns were not clear, disruptive behavior would occur. With unclear pathways, children would run into their fellow classmates or engage in non-academic communication.

Seating Arrangements. Seating arrangements are a major factor for teachers to consider when designing their classrooms. There are many different ways in which seating can be

arranged. The traditional approach to classroom seating was to arrange individual desks in rows.

Recently, however, many teachers are placing the chairs in clusters, circles, u-shaped patterns, or

a combination of the three (Bonus & Riordan, 1998). Today, researchers are investigating the

effects of tables in the classroom instead of personal desks (Taylor, 2009). Tables allow the

classroom to empower the student to own what they are learning. The "power" shifts from the

teacher in front of the classroom, to placing more responsibility on the student and the table

group. Tables encourage small group discussion and project-based learning. Consideration of

seating arrangement is not only useful to promote learning, but also to control problem

behaviors. Schwebel (1972) found that students who choose to sit in the front seats of the

classroom are more attentive, have higher self-concepts, and are perceived as being better

students by teachers and peers.

Empirical evidence that seating arrangements influences students' classroom behaviors is

limited, but available research provides mixed findings about the benefits and limitations of

particular arrangements. Although Wannarka and Ruhl (2008) found that on-task behavior (e.g.,

hand raising, writing) during independent work was greater when children were seated in rows

than in groups or clusters, many other studies show benefits of alternative seating. Marx,

Further, and Hartig (2000) found that students in a semi-circle seating arrangement asked more

questions than students placed in rows. They viewed this as a positive outcome because

children's question-asking behavior enabled them to obtain clarification, and receive

information. In similar work, Ridling (1994) studied the affects of three different seating

arrangements (rows, clusters, and u-shaped) on student's interactive verbal behavior. He found

that students using either clusters or u-shaped seating engaged in more interactive verbal

behaviors than those in traditional row seating. He also found that alternating seating

arrangements allowed teachers to make their lessons more active and collaborative among students. Bonus and Riordan (1998) also evaluated rows, clusters, and u-shaped seating arrangements. Two classrooms at separate schools were monitored with a behavior checklist filled out by the teacher (i.e. not beginning task promptly, inappropriate talking). Every three weeks the classrooms would switch from rows, to clusters, or to u-shaped seats. Their findings suggested the importance of alternating seating arrangements in concert with the task at hand. There was no arrangement that was effective for all lessons, but rather to increase on-task behavior, the seating arrangement must match the goal of the lesson. For example, if a teacher desired the students to be in discussion they should be in clusters, whereas if the teacher desired individual on-task work the students should be in rows. Overall the teacher needs to become flexible with how the seats in the classroom are arranged.

Bonus and Riodan's (1998) results suggest that seating should be flexible in order to accommodate a variety of learning activities. This could be accomplished in multiple ways, but most traditionally in the form of individual desks. It is important, however, to consider potential benefits of nontraditional seating. Schilling, Washington, Billingsley, & Deitz (2003) developed a study to investigate the effects of using therapy balls as seating on in-seat behavior and legible word productivity of students with attention deficit hyperactivity disorder (ADHD). They watched three ADHD students in a fourth grade classroom. First, they observed and monitored the student's in-seat behavior and legible word productivity in their regular seat. Later, they gave all of the children in the classroom therapy balls and observed the three ADHD students' in-seat behavior and legible word productivity. The results demonstrated increases in in-seat behavior and legible word productivity for the ADHD students when seated on therapy balls.

The teacher and the rest of students in the classroom stated that they preferred the therapy balls to their regular seat.

Density. Density refers to how compact or populated a particular space is. When evaluating environments, density has no psychological meaning, but crowding is referred to as a psychological state. Crowding is "a personal, subjective reaction that is based on the feeling of too little space" (Spencer & Blades, 2006, p. 64). Previous research has found that crowding has many direct behavioral outcomes for children in elementary school classrooms. According to Moore & Lackney (1994), high-density classroom conditions lead to increased aggression, hostility, movement, and distraction. Decreased social interactions were also found to be a result of a high-density environment. It was also shown that persistent exposure to a high-density environment resulted in lower academic achievement. The positive effects of low-density classrooms have equally profound effects on student's behavior and achievement. Moore & Lackney (1994) reported that children in a low-density environment showed greater participation, positive student and teacher attitudes, an increased sense of friendship, and higher achievement levels (as found in Spencer & Blades, 2006).

Maxwell (2003) investigated the relation of spatial density to elementary school children's achievement performance and behavior. For her study, Maxwell measured school crowding within two urban elementary schools by assessing three different domains. These domains were: total number of students in the school, total number of students in each class, and square feet per child (Maxwell, 2003). Maxwell then tested the participating children on two different reading measures to assess their academic performance. Her study showed how density and crowding play a role in academic learning and behavior. First, she found significant differences in academic achievement when class sizes are reduced from around 25 to 15

(Maxwell, 2003). Additionally, she found interesting sex differences regarding the effects of crowding on learning. Boys and girls essentially performed the same in lower spatially dense classrooms, but only girls' performance suffered as less space became available. With regard to space per child, girls' academic performance was negatively affected to a greater extent than boys', but boys' behavioral disturbances scores increased with less space per child (Maxwell, 2003). These findings suggest that both genders are vulnerable to negative effects of high classroom density, but they are manifested in different ways.

Visual Environment

Not only is the spatial environment influential to students, but also the classroom visual environment. Lighting, color, and personal displays are environmental factors that make up the visual environment in a classroom. Each should be evaluated in order to further promote student learning. The psychological effects of lighting and color are often underestimated, but by reviewing the research on these topics, it is clear that educators can change behavior and promote student learning by assessing their visual environment.

Lighting. The general consensus among researchers who have assessed lighting is that appropriate lighting improves results, reduces off-task behavior and plays a significant role in students' achievement (Schneider, 2002, as cited in Spenser & Blades). Thus, it is imperative that educators learn how to create "silent curriculum" pertaining to lighting. According to Winterbottom & Wilkins (2009), there are several aspects of lighting to be taken into account when considering this environmental feature. Classroom lighting is composed of imperceptible light, illumination at a student's desk, illumination and glare from projection screens, and pattern glare from windows.   Winterbottom & Wilkins did not collect data on the performance outcomes of such lighting, but they described the kinds of unsuitable lighting that was commonly

found in classrooms. Lighting was sampled in 90 classrooms across eleven secondary schools and experts explained the effects of lighting. They were looking at various lighting elements, including luminance at students' desks, glare from projection screens, and pattern glare from windows. Descriptive accounts of the lighting in these classrooms revealed several sub-optimal lighting practices. First, it was found that classrooms are often lit with inefficient forms of fluorescent lighting, a lighting source that is known to cause headaches and impair visual performance. In addition, the researchers found that classrooms in this study were over-lit with both excessive fluorescent lighting and excessive daylight. Lastly, glare from interactive whiteboards and dry-wipe whiteboards was very common in the classrooms observed (Winterbottom & Wilkins). Improper lighting practices, such as the practices mentioned above, impair academic performance and promote discomfort for students in the classroom (Winterbottom & Wilkins).

Another implication of classroom lighting on children's behavior was revealed in a study by Painter (1977) in which nine hyperactive children in a classroom were assessed before and after the removal of fluorescent lights. After the fluorescent lights were removed and replaced with incandescent fixtures, hyperactivity among the children decreased by 32.3 percent. Furthermore, attitudes of both the teacher and the children improved with the removal of all fluorescent lighting.

Sleeman & Rockwell (1981) stated that the amount and quality of light required is directly proportional to the type of task being performed. This basic concept informed teachers that their students need different lighting environments for different educational tasks, and allowed teachers to prepare the lighting environment according to the task. Also, it was reported in Sleeman & Rockwell that concentrated, bright light against dark backdrops caused continuous

adjustment of eye muscles, which leads to eye fatigue. Another important fact is that student work areas should never be directly illuminated due to the reflected glare that is produced. This glare negatively affected speed and quality of children's performance and resulted in fatigue and poor retention. (Sleeman & Rockwell, 1981).

Color. In addition to lighting, a classroom's use of color also must be considered in order to create the optimal learning environment. Sleeman and Rockwell (1981) stated that particular colors are known to have psychological effects, for example such as being warm, cool, stimulating, or relaxing. They also stated that color has the potential to change moods, judgments, and behavior. With regard to the classroom environment, different colors within the room have different behavioral implications.   For example, research has shown that warm colors such as red, orange, and yellow promote action-oriented activities. On the other hand, cool colors such as green and blue were found to help facilitate quiet, peaceful learning activities (Sleeman & Rockwell, 1981). Taylor and Gousie (1988) recorded similar information regarding color and presented it in the Council of Educational Facility Planners. Their article stated that warm colors increased blood pressure and muscular activity, while cool colors decreased both. In addition to warm and cool colors, the use of nature's colors, such as green and brown tones, created a comfortable and relaxed classroom environment (Taylor & Gouise, 1988).

Personal Displays. Another important feature teachers should consider when designing a classroom is to display student work on the walls. Another word for this is documentation. One famous theorist, Reggio Emilia, believed in the importance of documentation to make the student's current discoveries visible to anyone who entered the classroom ("Research into Practice: Reggio Emilia," 2011). Documentation communicated to the child that their work was valued, enlightened the parents of what their child is learning, and allowed the teacher to assess

his or her lessons and student's learning. Documentations, also called personal displays, have

also been seen to increase student self-esteem (Maxwell & Chmielewski, 2008). Maxwell and

Chmielewski (2008) selected random kindergarten and first grade classrooms to add

environmental personalization to make the classroom more meaningful to the children, and left

the control group classrooms the same. "Teachers and students were asked to create displays that

met the study's criteria of (1) personalization created by children, (2) the children had some

direct connection to the materials created, and (3) the displays were placed at a child's eye-level"

(p. 145). Teachers could choose from eight possible projects to personalize the classroom (i.e.

moving wall displays to children's eye level, paining a mural poster for the front door, pictures

of themselves on the walls). Kindergarten and first graders' self-esteem levels were measured

before and after the room change. Results revealed that within the rooms where the intervention

took place, the children's self-esteem scores improved. The self-esteem scores for the children

in the control group stayed the same.

Acoustic Environment

A significant body of research in environmental psychology has investigated the effects

of noise on human behavior. Poor classroom acoustics can create a negative learning

environment for many students (Shield & Dockrell, 2003). For example, Rivlin and Weinstein

(1978) compiled a review of research regarding noise within the classroom. They reported that

there are two causes of noise in the classroom: external noise and internal noise. External noise

included cars, airplanes, trains, or any other form of surface traffic. Internal noise was generated

by the daily activities of teachers and students within the classroom. Consideration of optimal

noise levels within classroom environments was complicated by the potential of individual

differences in response to differing acoustic conditions. Some individuals prefer to work with

noise, whereas others simply cannot concentrate with background noise. Noise is an important factor to assess in a classroom because it is related to several classroom components such as: achievement, spatial cognition, privacy, and density.

External noise. Bronzaft and McCarthy (1975) examined reading and achievement scores in a sample of children attending an elementary school within 220 feet of an elevated train. These researchers collected data from two different types of classrooms: classrooms on the noisy side of campus and classrooms on the quiet side. Students in the participating classrooms were of comparable intellectual and achievement levels and were taught using similar methods prior to the beginning of the study. Results indicated that children on the noisy side of campus overall had lower achievement test scores and reading scores that lagged three to four months behind the quiet side classrooms (Bronzaft & McCarthy, 1975). Interestingly enough, the publication of this article led the city of New York to action. The New York City Transit Authority installed rubber padding on the train tracks to reduce noise and the Board of Education placed sound absorbent ceilings in three of the noisiest classrooms. After these modifications were made, subsequent comparisons of reading scores showed that children on the noisy side were reading as well as children on the quiet side.

Internal noise. Recent research has found that the acoustical conditions in classrooms often do not fit the specific needs of young listeners (Klatte, Hellbruck, Seidel, & Leistner, 2010) These researchers examined the effects of classroom reverberation on children's performance and well-being while at school. Reverberation is created when a sound present in an enclosed space causes a large number of echoes to build up and then slowly decay as sound is absorbed into the walls. Dockrell & Shield (2004) reported that increasing the amount of acoustic absorption in a

room reduced reverberation. This can be done by installing acoustic ceiling tiles, carpet, or curtains.

Participants of this present study included 487 students who were tested over a one-week span. Students were asked to complete speech perception tasks with varying decibel levels of noise in the classroom. Results from the study revealed that children in classrooms containing long reverberation performed worse than children from classrooms with short reverberation (Klatte et al, 2010). Also, children whose classrooms had long reverberation reported a higher burden of noise in the classroom, which resulted in negative task performance consequences. Furthermore, children judged the relations to their peers and teachers less positively when compared to children from classrooms with short and medium reverberation (Klatte et al, 2010). These findings demonstrated how acoustics in the classroom negatively effect children's perceptions of their classmates and teachers, in addition to lowering their academic performance in the classroom.

Similar results were reported by Dockrell and Shield (2004), who investigated the impact of noise on performance in the classroom. They conducted a mixed experimental design study in six different classrooms by assessing performance on verbal tasks while being subjected to differing noise conditions. Dockrell and Shield found that performance on verbal tasks was negatively affected by classroom babble, which was defined as noise created by the students within the classroom. Furthermore, performance on speed tasks declined further when babble was superimposed with environmental noise (Dockrell & Shield, 2004). This study showed the detrimental effects of both internal and external noise on children's academic performance.

Thermal Environment

The human body strives to maintain a temperature of 98.6 degrees Fahrenheit. The four basic factors that affect body temperature are air temperature, radiant temperature, humidity, and air movement (Sleeman & Rockwell, 1981). The Iowa Center for Research in School Administration examined students learning in varied conditions. They concluded that the ideal thermal environment for learners was a temperature of 69-74°F, a relative humidity of 40-60%, and air movement of 20-40 feet per minute. Students in these thermal conditions acquired knowledge better than the children in environments with poor ventilation, over heating, and uncontrolled humidity (Sleeman & Rockwell, 1981). Possible mechanisms accounting for this decline in learning in suboptimal thermal conditions may be that hot, stuffy rooms or cold, drafty ones reduce the attention spans of children and limit their productivity (Sustainable Building Industry Council, 2001). Excessively high humidity levels can also contribute to mold and mildew, causing a whole host of other physical symptoms in children that may interfere with learning.

Harmon (1953) found three important reasons to consider a child's level of comfort when controlling the thermal environment of classrooms. First, he saw that developing children need a different set of standards than adults for their ideal thermal environment. Secondly, thermally induced stress can alter the learning and growth of children. And thirdly, the temperature of the classroom affected children's problem-solving capacity. Harmon believed the optimal learning temperature for the classroom to be between 69-73°F. He concluded that classrooms must be designed where teachers and students can control the heat and air conditioning, and that the classroom must have air movement, as well as a certain amount of humidity.

McVey (1969) suggested a rule to follow with young children was to have the teacher wear a sweater or jacket and then set the temperature to her comfort. Children, because they are younger, have higher rates of metabolism and are more active, thus making them more comfortable with less clothing on than the teacher. McVey's recommendations were in line with empirical work. Cooler temperatures were associated with children's increased levels of comfort, activity, productivity, and concentration (King & Marans, 1979). Similarly, Lowell and Ferome (1973) conducted an experiment with fifth graders assigned to an air-conditioned (70-74 degrees Fahrenheit) and non-air-conditioned (71-81 degrees Fahrenheit) classroom. They were asked to complete certain academic tasks like math, writing, and spelling. Findings showed a relationship between room temperature and type of performance on the academic tasks. Children in the non-air-conditioned classrooms had significantly higher elapse time and number of errors in their academic work than did the children in the air-conditioned classroom. Wyon (1969) also found that high temperature classrooms decreased student's performance in concentration tasks. Ryd (1970) studied academic performance levels and high temperature classrooms as well. Third, fourth, and fifth grade Swedish students participated in a study where they were measured on various performance tasks at two different temperatures 80 and 68 degrees Fahrenheit. His findings indicated that the students' performance was impaired at 80 degrees when compared to their performance at 68 degrees.

The Sustainable Building Industry Council (2001) provided some ideas for improving the thermal climate of the classroom. They recommend providing natural ventilation by opening the windows to the classroom. They also recommend analyzing room configurations and HVAC distribution layouts to ensure that all parts of the room are receiving adequate ventilation.

Teachers may want to provide shading for the windows with drapes or blinds to avoid 'hot spots' caused by direct sunlight.

Living Kinds

Living kinds includes plants and animals as important additions to the classroom that can aid in a student's overall development.

Plants. Many researchers have investigated the extent to which assorted additional elements within the classroom environment helped children feel comfortable and focused. Han (2009), for example, was interested in the effects of indoor plants on children's behavior and overall health. Previous research revealed that natural elements helped reduce mental fatigue and stress (Faber Taylor, Kuo, & Sullivan, 2001 as cited in Han, 2009). Han observed two Taiwanese classrooms. One classroom had six indoor plants in the back of the classroom, while the other classroom had no indoor plants. Both classroom were located on the same floor of the building and were adjacent to each other. Both were similar in education level and had similar physical environments in the classroom, such as size, shape, furniture arrangement, location, lighting, ventilation, noise level, and window views. The two classes were surveyed once every two weeks. The children in the classroom with the plants had immediately and significantly stronger feelings of preference, comfort, and friendliness than the students in the control group. They also had significantly fewer sick days and fewer punishment records due to misbehavior. No correlation between classroom and student academic performance was found, but this might have been because the experiment did not last very long or because of the quality of the teachers.

Animals. Not only do plants support children's personal development, but also animals in the classroom have been seen to improve children's empathy skills. Daly and Suggs (2010) surveyed seventy-five elementary school teachers on their own ideas of the benefits of having

classroom pets. Most teachers believed that classroom pets increased student compassion and empathy levels. Teachers also believed that having pets in the classroom contributed to children's socio-emotional and academic development. Kotrschal and Ortbauer (2003) provided empirical support for teachers' beliefs that animals in the classroom contribute in positive ways to student behavior and learning by investigating the effects of having a dog in the classroom. The researchers gave a dog to an elementary school in Vienna and observed the after effects of the dog's presence. Children reacted differently to the presence of the dog, but overall the classroom became more socially harmonious due to a decrease in aggressive and hyperactive behavior. Children who were once shy became more social. Communication increased between the children and teacher, and the children paid more attention to the teacher. If there were not so many hurdles for teachers to get through to have a dog in the classroom, dogs could act as a major role and benefit within the classroom.

Conclusion

Winston Churchill once said, "We shape our buildings and thereafter our buildings shape us" ("Winston Churchill Quotes"). There are many factors that come into play when designing an elementary school campus. Among the considerations are the outdoor play spaces, the communal areas (e.g., cafeterias, hallways, etc.), the administration offices and the classrooms themselves. Although each of these areas of an elementary school merits careful consideration in the design process, our primary focus for this project was the classroom because it becomes an additional piece to the curriculum. As evidenced in the literature reviewed above, the spatial, visual, acoustic, and thermal environments are all important elements to consider when designing a classroom. Each element has the potential to directly and indirectly affect student learning and behavior. Efforts to design an optimal learning environment would likely be most successful if

based on existing empirical evidence. To that end, in this senior project, we endeavored to create

a web-based resource for teachers and school administrators that would educate them on the

current research concerning the classroom environment. In providing this information, we

recognize that schools are often limited by lack of adequate resources and by logistical

constraints. Nevertheless, we know how creative educators can be and are optimistic that the

information provided in our website will inform, inspire, and motivate educators to create an

ideal classroom learning environment for their students.

CHAPTER 3

METHODOLOGY

Creating Our Literature Review

The first step in our literature review was to gather information using Cal Poly's Robert E. Kennedy Library Article Database. Brittany researched the topics of seating arrangements, space and furniture, personal displays, temperature, and additional factors. Katie researched the topics of student perceptions, lighting, color, density, and acoustics. Since the topic was multidisciplinary, we were able to use a wide array of journals such as Environmental Psychology, Architecture, Child Development, etc. Much of the research we found was outdated, so we referred to some newer textbooks found in the Robert E. Kennedy Library.

Designing Our Website

In order to create our website, we used iWeb which is a program found on Apple computers. We selected the "Notebook" template because it pertained most to our topic of classroom design. We put all the information on the site and then added photographs and artwork provided by creativecommons.org. The content on every page came right from our literature review, but was presented in a manner that's user-friendly and easy to read. Included on every page was a Fix It Quick box which was intended for teachers to quickly glance at the website and gain an easy, quick, and financially cheap idea for improving their classroom. Our intent and hope was that teachers can peruse our website with ease, knowing where to find information regarding each domain of the classroom environment.

Pilot Testing

We sent out a survey to seven current elementary school teachers to receive feedback on our website. The survey asked the teachers nine questions on a 5-point Likert scale from "strongly disagree" to "strongly agree." We also asked teachers what elements they would have liked more information about, and what we could have done to make the site more effective. We asked for feedback from teachers we knew personally. Of the teachers surveyed, one was Katie's sister, one was Brittany's internship advisor, and the rest were family friends. Our e-mail to the teachers included a link to our website and an attachment of our survey. Below is a sample of our survey.

Website Survey

Rate our website on a scale from 1 to 5:

1 is **strongly disagree**, 2 is **disagree**, 3 is **neutral,**
4 is **agree**, and 5 is **strongly agree**

1. I learned at least 5 new pieces of information regarding classroom environment.
2. I already knew most of the information provided.
3. After viewing the website, I want to make some changes to my classroom.
4. I will use some of the Fix it Quick ideas.
5. There was enough research provided to convince me that these physical elements of the classroom are important.
6. The website is aesthetically pleasing.
7. Reading this website was a waste of my time.
8. I would send this site to my fellow teacher friends.
9. I would reference this site again for ideas on how to change my classroom environment.

Identify the elements you wish the site had **more** information on:

Lighting   Color   Personal Displays   Space and Furnishings

Seating Arrangement Density   Thermal Environment

Acoustic Environment   Plants   Animals

What could we change about the site to make it more effective?

CHAPTER 4

RESULTS

Website Design

For the creative portion of our senior project we created a website using iWeb. We built

a total of fourteen different pages: Welcome, Our Approach, Lighting, Color, Personal Displays,

Space and Furnishings, Seating Arrangements, Density, Thermal, Acoustics, Plants, Animals,

About Us, and Resources. On each physical element page there was a main research finding at

the top, at least two photos, a summary of the current research on the topic, ideas on how

teachers can improve their classroom, and a Fix it Quick box. The Fix it Quick box provided

ideas of fast and inexpensive ways to create an optimal learning environment. Detail on the

content of each page is provided below. Screen shots of the pages in the website are available in

the appendix. The URL of our web page is

http://web.me.com/brittanyallen210/The_Classroom_Environment/Welcome.html.

Welcome. The Welcome page consisted of: a picture of an interior to a classroom, a

quote by Winston Churchill about the importance of buildings, and a welcome note to the

teachers, inviting them to click on the Our Approach page.

Our Approach. The Our Approach page consisted of a description of Ann Taylor and

George Vlastos, the two main theorists whose philosophy we followed throughout our entire

project. On the right side of the page, we described the break down of our website and what

information was provided on every page. Three pictures were shown on the left hand side; one

was children drawing a picture of what they wish their classroom to look like, another was a

sketch by an architect of an elementary school, and the last photo was a picture of one of Reggio Emilia's classrooms.

Lighting. The lighting page consisted of lighting "do's & do not's". Based on the notion that appropriate lighting reduces negative classroom behavior and increases academic achievement, this page provided teachers with information on how to correctly light their classrooms. Also, there was a photo of a classroom that serves as an excellent example of a well-lit classroom. The Fix it Quick box at the bottom of the page suggested using incandescent bulbs instead of fluorescent, as well as only using lamps with specific color temperatures.

Color. Color is known to have psychological effects on human beings. This page of the web site explained the psychological and physiological effects of warm and cool colors on children. Additionally, information was provided on how the manipulation of color can facilitate and promote different activities and behaviors in children. The Fix it Quick box gave educators simple, cost-effective ways of altering the entire look and feel of their classroom by using color.

Personal Displays. The Personal Displays page addressed how personal displays on the walls increase students' self-esteem. It discussed how personal displays should be made and displayed so they are meaningful to the students. There was a picture of a classroom with a poor personal display. This page also offered five craft ideas to create personal displays. One was a picture showing one of the five ideas. The Fix it Quick box reminded teachers that they already have work done by their students and that they should display it on the walls of their classroom.

Space and Furnishings. The Space and Furnishings page was about how the idea of space in the classroom is changing. The page emphasized that the teachers' pedagogy must match the space of the environment. The page also offered six ideas on how to improve the

space and furniture in the classroom. The Fix it Quick box encouraged teachers to write down their beliefs on how children learn best, and to model that belief with their classroom space.

Seating Arrangements. The Seating Arrangements page had information on what types of seating arrangements encourage which type of behavior. There were two pictures of layouts of seating arrangements. Below this information, a section on alternatives to desks and seats can be found. Three examples were given: tables, therapy balls, and standup school desks. There was a video on therapy balls used in the classroom as well as a video on standup school desks used in a classroom. Both showed positive results. Two pictures were provided; one was a picture of a teacher helping students in a table group, and the other of students on therapy balls working in the classroom. The Fix it Quick box encouraged teachers to rearrange their seating arrangements to fit the needs of their lesson.

Density. Density is a more complex environmental factor, thus this page began with a definition of density within the classroom context. We presented the reader with information about the effects of density, crowding on children and ways to decrease negative effects of crowding. On this page there were two different comics that mocked the current state of public classrooms. These pictures were meant to be lighthearted while at the same time explain the reality of the crowding problem in schools.

Thermal. The Thermal page discussed how the temperature in the classroom can affect student's academic performance. The page consisted of information about the optimal thermal environment for the classroom, as well as five explanations of why teachers should be concerned about the thermal environment of the classroom. The page offered ideas of how to improve the thermal environment and the Fix it Quick box also offered ideas like opening the classroom windows and using fans.

Acoustics. The Acoustics page gave an overview of the current research regarding internal and external noise. Furthermore, it provided the reader with information on the effects of noise of student behavior. Along with the text information were some pictures to make the page more aesthetically pleasing. One picture stated that, "listening in a room with poor acoustics is like reading in the dark."

Plants. The Plant page consisted of information on the impact of indoor plants in the classroom. The page also offered ideas on how to incorporate plants into the classroom. The Fix it Quick box offered up the idea to plant your own seeds and watch them grow. There were two pictures of plants in the classroom.

Animals. The Animals page discussed the different ways animals in the classroom have power over children's behavior and socio-emotional development. The page consisted of what types of animals a teacher could have in their classroom and tips for bringing a new pet into the class. A video was provided about a school that invited dogs to their campus and the children could practice reading in front of a non-judging dog. Reading to the dog was shown to increase children's confidence levels in reading. There was a picture of a girl reading to a dog and of three children playing with a hamster in the classroom. The Fix it Quick box offered suggestions like buying a fish, or arranging a show and tell day for the student's animals.

About Us. The About Us page had a picture of Brittany Allen and Katie Hessick and background information on their relationship. The page described why they were interested in this topic of research and how they hope that researchers continue to pursue learning about the power of the classroom environment.

Resources. The resources page included all of the pictures we used on the website, the videos, as well as the books and articles used to gain the information for the site.

Pilot Testing

Of the seven participants contacted, we received six completed surveys. The completed surveys can be found in the appendix. Participants provided information about both the content of the site and the format.

Content. All of the teachers agreed that reading the website was not a waste of their time. They all agreed or strongly agreed that they wanted to make changes to their classroom after viewing the website. All but one agreed or strongly agreed and that they would use some of the Fix it Quick ideas. All but one of the teachers also agreed that they would reference the site again, and that there was enough information provided to believe that the different elements were important. Three teachers wished the website provided more information on seating arrangement, two teachers wished for more information on personal displays, and one teacher wished for more information on acoustics. Three teachers agreed that they already knew a lot of the information provided.

Format. Feedback on the aesthetics of the website was inconsistent. One teacher recommended that we redo the layout of the website because she didn't find it very user friendly, but then another teacher commented that she found the website user-friendly and that highlighting some areas with color made it easy to read. Another teacher recommended adding more visuals to certain elements while a different teacher stated that she loved the colorful text and pictures.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

Education in the 21st century is on the move. It is constantly changing with new

technologies and differing theories on the optimal way to teach our children. The environment

of the classroom must become part of this process of change. The state government,

administrators, and educators can be active members in helping to create an environment for our

children that will adapt with the learning styles of today. Environmental theorist, Taylor,

concludes, "The ideal educational environment is a carefully designed physical location

composed of natural, built, and cultural parts that work together to accommodate active learning

across body, mind, and spirit" (Taylor, 2009, p. 31).

We embarked upon this project to inspire and educate educators on the importance of the

classroom environment. Ultimately, our goal was to share the current research with current

teachers and present it in a way where the teachers would believe they could make these changes

to create an optimal learning environment. It is hard to be conclusive on the potential

contribution of our website to that goal because the teachers shared mixed reviews of the site.

We were encouraged by the findings that almost all of the teachers wanted to make

improvements to their own classroom based off our website and that they were planning on using

our Fix it Quick ideas. We were discouraged by one teacher's comment that she felt too

restricted to alter her classroom as a public school teacher.

In a revision of this project, we would choose fewer physical elements in the classroom

and explore these elements in greater depth. Multiple teachers had wished for more information

on seating arrangements and visual displays. We would have also given out our survey to more

elementary school teachers. We would have visited neighboring elementary schools and taken pictures from real classrooms to include in our website. Elementary school classroom environment research was limited so we would have expanded the project to middle school and high school environments as well.   If we had more time and resources, we would have liked to have taken an actual elementary classroom and changed the physical environment according to our current research. Or we would have paired with an architecture major and created an ideal learning environment sketch from scratch.

Although we struggled to find and compile all of the current research on the classroom environment, we hope that our website can be used by teachers as a tool of reference when designing their classroom. We hope that this project made participating teachers more aware of the power of the silent curriculum, the classroom environment. In addition, we recognize that promoting the importance of the classroom environment will only be effective if researchers become re-interested in the topic of the intersections between the elementary school environment and child development. As schools respond to the changing demands of 21st century learning requirements, perhaps what is currently an overlooked topic will again demand the attention of researchers, teachers, administrators, architects, and others involved in creating learning spaces for children.

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APPENDICES

Appendix A: Hard Copy of Website

Appendix B: Completed Surveys