Detrimental Effects Of White Valued Walls In Classrooms

Kathryn J. Grube

ABSTRACT

Contrarily to color research, white values of paint are the most commonly applied finish selection on classroom walls today. White walls have been used in American schoolhouse settings since the first discovered paint, also white, was invented and made available some two hundred years ago. Originally, white paint was seen as hygienic and structured in demeanor, and was used as an agent to enhance visual capabilities in closed settings due to dark-hued building materials and an absence of electricity. Since then, using white paint for classroom wall finishes has remained as a perpetual design tradition that is causing a disservice to our academic and educating potentials. White walls are proven to cause detrimental psychological effects, such as anxiety, disruptive behaviors, lack of focus, and depressive moods to students and educators that spend time within the space. These types of effects dull-down learning capabilities and discourage morale. Color research has proven these negative facts for over a century now, but white walls remain constant in our educational facility design from a fallacy of misperception largely due to tradition, misinformation, and ease of maintenance. The question is why.

INTRODUCTION

Interior educational environments with white values of walls are known to induce anxiety, dissipate focus and concentration, and be a foreshadowing to petulance in end users. In 1947, Louis Cheskin, founder of the Color Research Institute of America, publicized his research discoveries as public warnings when he expressed, "White walls, as we know, are an optical strain and a psychological hazard" (Cheskin, 1947. p. 158). More evidence repeating Cheskin's findings has occurred throughout the decades, however, values of white have withstood these types of publicized cautions, and have somehow managed to remain as a design staple on the classroom walls of our educational interior architecture. Despite the vast amount of classrooms that have traditionally-colored white walls, values of white used on classroom walls give the learning environment the psychological appearance of being sterile and depressing, and can also cause glare, eyestrain and discourage learning (Birren, 1961; Mahnke, 1996). Color schemes with various values of white, including off whites and grays, when used on the walls within a learning environment can be perceived "institutional-like" from its origins of use in medically sanitary and hygienic oriented facilities and in structured schoolhouse settings, and ultimately become psychologically monotonous to its end users. This same droning feeling can be present in the space when shades of beige or taupe are used. These types color schemes are often referred to as being monotone, due to their unvarying quality and lack of psychological stimulation and interest to the end user of a space. Fittingly enough, the depression era of the 1930's was also referred to as the "taupe age," which speaks descriptive volumes of melancholy and gloominess that can be representative with monotonous color schemes (AFCEE, 1999).

In his 1976 case study, Küller showed how an environment with color not only benefits humans psychologically, but also increases focus and positive behavior, and ultimately enhances learning. In addition, Küller showed that being in white or gray class-

room environments has a negative effect on its inhabitants, as shown by increased student irritability and difficulty maintaining concentration. Both of these symptoms proved to be detrimental to the promotion of learning (Küller, 1976). The same types of negative reactions, due to white walls and fluorescent cool white lights, have been observed in many case studies involving learning environments such as Grangaard's dissertational study in 1993. A person sees the greatest overall distribution of color that is present within a given setting. In a classroom environment, the largest distribution of color comes from the walls. The walls have more visual weight due to their mass than furnishings or artwork possess alone; hence, the occupants of the classrooms generate their feelings towards an environment based on what the wall color portrays. Despite what color research has shown, the tradition of using white walls continues, and is a great disservice to students and professionals. "Industrial white, off–white and white must not be considered as satisfactory" [for learning environments], (Grangaard, 1993, p. 93). In 1978, the National Bureau of Standards advised this very same concept in Pierman's report:

> At present, the selection and specification of color in certain areas of our man-made environment, as buildings, is largely related to anecdotal evidence of effectiveness or only to changing styles and variable tastes of individual designers. While this condition may only result in superficial displeasure of users, in some instances it results in critically altered functions and goals (p. iii).

Values of white are neutral shades and are also considered "classic" in nature, but the presence of color is far superior than the absence of color, classic or not, for end users in a classroom (Sherwin Williams, 2011).

ORIGIN AND USE OF WHITE WALL TRADITION

From where does the tradition of using white painted walls in our classrooms originate? White walls have been in existence since the ancient Egyptians who discovered that mixing gypsum and chalk would create a white limestone plaster. They also used this concoction to make a white wash that covered the inside and outside of the walls of their homes to combat the fierce Egyptian heat (King-tut uk org, n.d.). This practice of using natural minerals stood the test of time for thousands of years, which eventually led to the development of the first type of paint medium made with milk in the 1800's. Mixing gypsum, lime, and earth pigments with milk achieved the first type of "paint", which was called "milk paint". During the 1800's, most settlers in America had access to a cow or goat to the make the simple milk paint recipe that was used inside of country homes and on furniture. (The Old Fashioned Milk Paint Company, n.d.). White was the first hue to be discovered and manufactured. The newly available white milk paint became dominantly used due to its ability to transform architecture by providing a clean, fresh finish that brightened dark interiors.

Architecture styles in the 19th century stripped away the decorative ornamentation of previous architectural periods, creating the new vogue of simplistic lines and clean palettes (Wigley, 2001). Like all historical architecture through time, the 19th century style of architecture was based on the trends of the latest fashion. During the 19th century, fashion and architecture were luxuries that could only be enjoyed by the wealthy. "Paint colors have historically been responsive to economic and cultural trends, as in the 19th century use of white paint to indicate wealth" (Vodvarka, 1999, p. 6). Literature was also prevalent during the 19th century and writings of Mark Twain, such as *The Adventures of Tom*

Sawyer published *in* 1876, captivated many audiences. Derivative of the poverty-stricken Tom Sawyer character, whitewash was often referred to as the "poor man's white paint" (Twain, 1876).

Another instance of the promotion of white came from the architect and writer Le Corbusier. In his book of 1925 *The City of Tomorrow,* he wrote that all of Paris should be white to purify the city, which was a reference to whitewashed Mediterranean houses of ancient times. Le Corbusier had the opinion that the white wall was to be used to exhibit art, so that anything that did not fall into the category of modern would look like a "stain" upon it. He felt a white wall was the perfect background and would purify artwork that was hung upon it. Although it is anecdotal, it appears that Le Corbusier could be at the forefront of having museums display artwork on white walls, which appears to have begun in the late 1930s at the Museum of Modern Art in New York City. Exposing society to the prolific use of white walls only confirmed the thought process that white walls were superior environments for hygiene and structured institutional settings. This could be a correlation to the tradition of using white classroom walls with colorful student artwork displayed for "decoration" as is similarly done in museums. Le Corbusier, after all, was one of the most prominent architects of his time, but did not focus on educational facilities design. He is often criticized for his use of futuristic, "modern" elements in his creations that failed to promote the benefits to the inhabitants. "What was the function of a house? Le Corbusier arrived ('scientifically' he assured his readers) at a simple list of requirements, beyond which all other ambitions were no more than {romantic cobwebs}" (De Botton, 2007, p. 22). Nonetheless, Le Corbusier had an implausible impact on the field of architecture and he and his designs are still commonly studied in architecture and design programs today. The history and tradition of the use of white paint in classrooms continues along with Le Corbusier's legacy, regardless of what has been proven otherwise.

The detriments of white walled environments are not obsolete for only classroom environments, but do hold an overall consistency with their negativity towards learning when used in various interior settings. In 2003, Englebrecht of the Chicago office of Perkins and Will (architects/interiors) wrote a paper that was presented at NeoCon (the largest design exposition and conference held in North America each year) entitled, *the impact of color on learning.* In it, the author discussed an independent study that was conducted in 2003, and designed to confirm whether color did or did not affect accuracy in business environments. The study included businesses that used white and off-white walls in their working environments versus environments enriched with color. In the white and off-white working environments there was a 25%+ reduction in accuracy and efficiency of its workers. This independent study confirmed the U.S. Navy's conclusions that a colored room does increase the accuracy of its inhabitants (Engelbrecht, 2003). Another entity that has similar convictions about the harmful effects of white wall use is the United States Air Force. In their *Facility Design and Planning* pamphlet, the benefits color provides to function and aesthetics is discussed at great length. This discussion also includes the benefits to classroom environments with proper color use. The second item found under the heading "color considerations include" states "the elimination of too bright values, such as stark white, that can cause disturbing wall reflections and glare" (p. 8).

ADVANCEMENT IN PAINT

During the 19th century, milk paint was accompanied with whitewash for a paint

medium to use on building interiors and exteriors. Whitewash was used in early America as a more durable alternative to the milk paint, but was made from calcium hydroxide or slaked lime and chalk. This gave whitewash its white color and opaque final finish. Paint began to evolve in quality by the 19th century with the addition of white lead to the whitewash mixture. This lead provided opacity to the paint and exhibited better "hiding" characteristics on the surface to which it was applied. The white lead also gave more resilience to the paint and assisted in eliminating the problem of mold and mildew from developing. (Chase, n.d.).

Paint technology developed further in 1916 when this white pigment with superior coverage and durability allowed for a paint to be available that far surpassed the whitewash derived from natural resource minerals. In the 1920's, the new white paint gained popularity for use in American interiors in the popular Colonial Revival architecture occurring since the early 1900's (Stark, n.d.). This novel white paint gave a new sense of being clean and "hygienic" to inhabitants of commercial and residential architecture. White was once the signature paint color for the wealthy as was shown by its use on the interiors and exteriors of buildings and homes. Its use denoted a pronounced denominator of being fashionable, clean, and bright within its characteristics. White walls were also predominant throughout the 1930's when advancements in manufacturing technologies of paint pigments allowed new access to paint to other classes of people besides the wealthy (Stark, n.d.). Up until the 1950's, lead was used in oil-based paints to act as a binder that would also inhibit mold and mildew growth, hence giving way to lasting durability. Being found toxic, lead based paints were eliminated after 1950, giving way, in the past 30 years, to water based paints using acrylic resin emulsions. As technologies advance, the demands for environmental friendly qualities continue to become requirements. Titanium dioxide replaced the white lead in the white pigment. Titanium dioxide is also still used today in both white and colored paints for superior coverage and hiding capabilities (Chase, n.d.). It seems apparent that the traditional use of white paint seems to stem from its lengthy availability for human use. It was the first of all hues of paint to be manufactured and all other colors of paint still today contain a portion of white paint, with its titanium dioxide, within their recipes for the base mixture.

School buildings in the U.S. existed long before paint itself ever became available. The first school building was founded on April 23, 1635. It was the Boston Latin School, located in Massachusetts and is still in existence today (Boston Latin School Association, n.d). With the development of white wash in the U.S. nearly a century later, the newly available finish applied on the walls in classrooms had to be a most welcomed, refreshing, and functional change for the students and educators. Before this, the space was habitually dim in nature due to the dark hues given off by the construction materials available at the time. These same materials would also darken over time due to natural aging of wood, as well as the absorption of soot and wood ash by the floors, walls, and ceilings from the heating that took place in winter months.

An additional factor for white walls becoming a national tradition for schools is that the widespread use of electricity did not begin in to the U.S. until the late 1880's. At this time, Thomas Edison began implementing his patent for electricity distribution, which made practical use of his reliable incandescent light bulb. Electric lighting was another new innovation that was originally provided for the wealthy. It was first used in Chicago in 1880 at the Palmer House Hotel for the Republican National Convention. The general

public, including school facilities, which were located in major cities in the U.S., did not have access to electricity until 1920 (Tell City Electric Department, n.d.). By then, the advancements in technology had allowed white wash to evolve into a far superior coverage medium in the form of white paint. White wash and white paint, both being bright in their capacity to reflect light, would have allowed a more functional setting for teaching and learning to occur. The brightness alone of the white-hued walls would have been far superior for educational performance as compared to the previous learning environment, whose functions were restricted by the availability of daylight, oil lamps, and candles in the already dark-material constructed schoolhouse structure. With white being the first available color for washes and paints, as well as being the most functional classroom wall color solution during the time of its invention, it is no wonder that the tradition of using white on classroom walls as a design standard was born.

NEGATIVE EFFECTS OF USING VALUES OF WHITE: A BRIEF WALK THROUGH HISTORY

The use of white paint on classroom walls, with its high light reflectance value, causes the pupils of the eye to constrict and results in a distraction to vision (Birren, 1961; Cottreau, n.d.; Mahnke, 1996). From the mid 1950's throughout the 1970's, white wall use became so widespread that most interiors, including both residential and commercial structures, implemented them as a common rule of thumb without question (Mahnke, 1996). Designers in the 1960's and 1970's were using more glass, aluminum, and steel in their interiors around the world due to technological advancements. They did however, have the misconception that if all the walls were painted white, then the teacher would become the focus for the students and not the environment. It sounded good in theory, but the results of the design on students were an unintentional failure of mass proportion. This period of architecture also fell short of its hopeful aspirations to be innovative and has been coined "soulless" and sterile (Fielding, 2006).

In the late 1950's, ten years after Louis Cheskin's psychological hazard findings of white walled classrooms were first presented, a West German government agency's study on color headed by Heinrich Frieling, founder of the Color Psychology Institute of Germany and founding member of the International Association of Color Consultants/ Designers (IACC), concluded the same, that white walls depicted an environment that was "empty" and had "no vitality" (Mahnke, 1996). Frieling conducted his study on over 10,000 children, ages five to fourteen from different regions around the world. After removing the children from white or gray rooms and placing them in rooms of color, levels of nervous tension lowered, concentration increased, and learning performance accelerated. Additional studies by various academic researchers in the 1980's were conducted using Frieling's color palette systems and all were unanimously conclusive of the positive influences of color to lower stress levels, reduce off-task disruptive behaviors, amplify academic performance, and most impressively, increase IQ scores (Pilaroscia, 2010).

After 50 years of proven research, designers finally started to understand and appreciate the value of color and in the 1980's began implementing colored walls in small quantifiable measures. Sadly, the use of colored walls in academic settings was of small proportion compared to the number of schools in operational existence and the implementation of colored walls in classrooms was short lived due to the influence of tradition, people's conditioning of its use, and the design professionals who were unaware of the

significance of color's psychological impact. The classroom environments of schools tend to follow the pathway of industry and return to the "old faithful" color selections of white values regardless of what the negative scientific research states about its use (Grangaard, 1993). This correlates with the fact that schools were originally designed as learning "institutions", where hygiene, discipline, and structured order set the precedence for their inhabitants. This mentality in design is seen in various establishments such as medical, prison, and educational facilities whose name often includes the word "Institution".

Although never truly leaving the design staple category, in the 1990's, an encompassing trend resourcefully rejuvenated a palette of white walls back into the lime light of use in interior design. Designers became more "creative" in their use of white paint. To justify the creativity, gray was added with the use of bright white and was portrayed as an "innovative technique" in design concepts. The only difference from previous white wall use was the contrast exhibited in the design effect from using brilliant white walls with shades of gray in carpeting or other finishes in the room (Fielding, 2006; Mahnke, 1996). Institutional gray infiltrated floors, walls, and furnishings in all types of building structures, including schools. These types of monotonous colored environments used in the 1990's were once again widely proven to create the negative effects of anxiety, fear, nervous tension, and depressive sorrow with its inhabitants. Although residential wall colors were quick to change and varied according to the preferences of the owners, classroom design remained stagnant with its vast use of white walls. Despite the new terminology of the "creative innovation" in the 1990's, the sterile color finish selections were rejuvenated as design standard excellence and solidified their place within classroom settings.

WHO DESIGNS AND PLANS OUR SCHOOLS?

Responsibility

So, who is responsible for setting the standards for color use and finish selections within American classrooms? It seems that it should be the US Department of Education (USDOE). However, the US DOE is not responsible for school design, planning, or construction of our nation's school facilities. The US DOE functions to establish policies on the different aspects of federal financial aid for education, collecting research/data on our nations schools, and enforcing educational laws in accordance with privacy and civil rights mandates (USDOE, 2011). The design and planning of school facilities is actually left up to each individual state to decide what is to be implemented in their state's school facilities. Each state has its own board of education that determines the facility guidelines that are to be used for the design and planning of its K-12 public schools. Of course, the facility guideline manuals in all (50) U.S. states must abide by the safety, health, and welfare of its occupants as determined by national or state and local building codes. When it comes to the benefits of color however, not one U.S. state appears to offer any type of standardized guideline for its educators or design professionals to utilize to promote learning through color use in the classrooms. Again, without the knowledge of color relayed to the ones who write the checks as representatives for the construction of our nation's schools, how can color ever become a priority to enrich our learning environments?

The boards of education in each of the 50 states typically leave color selection up to the professional architect. The architect is assumed to have the knowledge, skills, and training to expose and recommend color to the educational facilities owner representative

for a given construction project. Because color is almost never recommended to the school owner's representative by the architect, the "disconnect" that exists between the benefits of color in the classroom and its implementation becomes obvious. Color selections being typically specified by the architect on the contract documents, such in the written architectural specifications or construction plans themselves, and are then to be submitted for approval to the owner's representative from the school facility on an individual basis of project construction. The architect becomes the ultimate recommendation for color usage or lack of for classroom environments. The faculty, staff, and administration of any school facility, specialize in what they are educated and trained to do: educate students and run the operations of the facilities that service them. These educational facility employees, who are often owner's representatives for a given construction project, trust their project architect and design team for their guidance in achieving the best possible educational facility design available through their low-bid method of project award. It is expected that the architect's experience will guide the school employees in the phases of design and construction and will best serve the functions of their learning facility. This leaves the recommendations for the selection of colors to the project architects, which are again to be turned over for owner approval. Without the services of an interior designer, color consultant, or architecture firm that promotes color use in classroom environments, the outcome of the school's construction project once again remains at the mercy of what is recommended to them by their hired architectural design team professionals.

The use of white paint, as designated by the architect for classroom wall paint, is one of tradition and is unfortunately misconstrued as being effective in enhancing learning performance within a classroom setting (Fielding, 2006). Architects, general contractors, and subcontractors, who are the lowest bidders, are usually awarded school construction and renovation contracts due to state funding spending requirements for public works projects. Educational facilities limited funding, carefully monitored budgetary constraints, and fast track completion schedules to maintain school year occupancy, often compromise the quality of workmanship provided for the project. With these factors in mind, the expectations of school owners often go unmet after a contract is awarded to the lowest bidder. This is often due to the low bidder's poor performance exhibited from inexperience and uneducated decision-making, which often results in delayed project completion. (Barnes, 2010; Kahiwagi, 2010; LePatner, 2008; Schumaker, 2003).

By selecting a traditional, neutral white value of paint for the walls, less time is needed by the design team and costs are reduced as compared to the time and expenditure necessary to design a space with well-developed color schemes conducive to learning. The neutral paint selection also eliminates the need to hire an interior designer or other type of color consultant, which would also result in added costs and additional time accrued for the project's completion. There is a schedule to meet and generally only a low profit to be made, so color variety in wall paint often is not deemed a priority. Without a written requirement for colored classroom walls requested by an educational owner representative and provided by the architectural firm for other trades to provide, colored hues of walls become obsolete and are not provided. If the educator representing the school's facility does not request color, the design team or project architect typically assigns a color for the classroom walls and then recommends it to the school's representative for approval. Once the owner's representative approves it, it is executed.

Consequently, architects, who are required to have a complex knowledge of the

exterior skin of a structure, and the building systems and technologies for maintaining safety and function, often consult with engineers for the interior provisions of electrical, plumbing, and mechanical codes and requirements. The education and training architects receive regarding structural and safety requirements of a design is extensive, but it appears, in retrospect, that the instruction for specialty items, such as environmental color psychology within the interior built environment is minimal. (Lippman, 2010). Lippman, who chaired the American Institute of Architects New York (AIANY) Committee on Architecture for Education from 2001 to 2004, is also a senior staff member of the Educational Practice Group at a New York architectural firm. He confirms, in his 2010 book on evidence-based design of primary and secondary schools, that there is a lack of specialty knowledge introduced in architect educational curriculum:

> Building public schools in the United States has become a specialized practice in which the architect can potentially evolve from an artist whose interest is in the exterior aesthetic to a leader in the field who not only values and appreciates design but, most importantly, understands how people acquire and master both in- formal and formal skills…While design professionals should have these skills, they must also be trained to analyze research on how people learn and transfer this information to the design of places that promote learning. If design professionals desire to advance their role from merely building to understanding how learning occurs, they can become agents of change in the creation of this particular building type (p. 2).

With meager budgets and construction funding constraints, fast track scheduling, and customary methods for designing school projects, it is easy to perceive why interior color variety on classroom walls often falls to the waysides of tradition.

A BRIEF HISTORY OF COLOR RESEARCH AND CLASSROOM WALL COLOR RECOMMENDATIONS

1900 – 1950's

As early as 1900, various designers, planners, and facilities groups from multiple nations have been recommending what colors and types of finishes should be implemented in classroom design so that occupants will benefit academically and psychologically, and the functional needs of the learning facility will be met. For example, "Different colors themselves convey different impressions to the mind, yellow, for instance, conveys the impression of luminosity or brightness" (Hurst, 1900, p. 34). As George Hurst stated back in 1900 and also as Isaac Newton discovered in 1666, colors have meanings and establish moods that cause a psychological response in any given setting.

In 1929, the Interstate School Building Service in Nashville, TN released a book entitled *For Better School Houses*, that promoted the colors that would best support the moods or feelings most beneficial to the students and instructors in school settings. The publication recommended subtle paint values of bluish-green and peach for areas that students would use for long-term durations. The basis for determining what paint colors would work best in various areas for ceilings and walls was a derivative of the scientific research done by the Illuminating Engineering Society (IES) (Interstate School Building Service,

1929). The use of color hues by warm or cool category on the Munsell color wheel were also strategically placed in order to give an adverse psychological effect to allow the room to "feel" warmer or cooler depending on the function of the given space. For example, warm tones of "peach" were implemented in areas with vaulted ceilings or in windowless or darker rooms to counteract for the absence of natural light. White, ironically, was only utilized on storage area walls and ceilings to assist with the installed lighting during the short time an occupant went in to stock room to acquire needed items (Interstate School Building Service, 1929).

Wall color variety continued to be recommended in classrooms throughout the 1940's. In 1946, New York's public school system tested learning performance and achievement increases in students by using different color schemes on classroom walls. Pastel shades were previously adopted state wide in 1943, and had six color combinations with the sixth being peach and rose in hue. New York and a very few other schools in the United States, were utilizing the principles of color dynamics, which paint companies were promoting in the 1940's. These colors consisted of medium to light value hues of blues, greens, and yellows for example, that eliminated the excessive brightness of the white paint color as well as the depressing nature of dark colors. The paint companies also promoted the use of focal walls behind the instructor that were painted in a darker or lighter value than the side walls. Again, the feeling of color was also endorsed to put cool colors on classrooms that had south or west exposures and warm colors with north or east exposures. The sole colors of white paint recommended in the school settings were either off-white or light cream and were only to be placed on the ceilings (*Time*, 1946).

New Jersey school systems adopted New York's concept of pastel paint shades in the late 1950's when they replaced the classroom finishes in a select number of schools that had yellow-brown wall paint, black chalkboards, dark flooring, and dark finished desk furniture for both the students and instructors. Along with the pastel shades used for the walls, chalk boards changed from black to green, flooring was changed to a light neutral, and furniture with natural wood finishes was designed and installed in classrooms. The reasoning for these changes was related to scientific discoveries that showed changing the colors of the classroom finishes and furnishings, would result in improved student academic performance and increased concentration. They also used color to assist in the diminution of the number of cases of eyestrain within the student population. Based on these scientific discoveries of the power of color, New Jersey school boards promoted the use of color because of the positive feelings it induced within a school and the resultant improvement in students' attitudes towards school. This, in turn, led to a more attractive and enjoyable place for students to attend (Chamberlain & Kindred, 1958).

1950's through Present Day

From the early 1920s through the 1950s until today, researchers and design professionals continue to recommend and proclaim the power of color variety on classroom walls. As it was originally recommended in the 1920s, an accent color on the teaching wall or wall behind the instructor that is different in hue than the side and back walls is still recommended today. American Industrialist and founder of the Ford Motor Company, Henry Ford, also used this concept of a focus wall to maintain concentration for his students training to be placed on the assembly line in the early 1900's (Fielding, 2006). The differ-

ent color on the focus wall achieved a brighter and uniform illumination and allowed the students to focus directly on the tasks in front of them and maintain progression in advance of their supervisors (Fielding, 2006). A color that is a shade darker in value than the other three walls, or a contrasting shade or hue, is recommended on the teaching wall to provide distinction from the different colors of the chalkboards or white boards that are present in the room and inevitably attract student focus (Emory College, 2010; Pile, 1997; TES Magazine, 2008). The colored accent wall also reduces eyestrain in students while taking notes and provides relaxation to the eye's pupil, which can otherwise have an unpleasant reaction when focusing on the monotonous tones emitted by glare (Birren, 1961; Cottreau, n.d.). Specific colors for classroom walls are recommended based on the learning objectives for the setting, desired functions of the room, and environmental considerations.

All colors that are recommended by researchers, however, appear to be of various muted values that correlate to the light reflectance requirements specified. Warm color palettes, such as shades of yellow and peach or cooler palettes of blue and green, account for the majority of hues recommended. Warm colors can also be selected to energize students; while cooler colors can be implemented to provide a relaxing setting that calms students (Cottreau, n.d.). As with the teaching wall recommendation started back in the 1920's, color hues for classroom walls are still being recommended in order to perform sensory tasks to change the occupants' perception of the temperature of the room in relation to the school's climate zone location. Warmer colors are recommended on east or north exposures, or in climates that have cooler climates or long winter months. Similarly, cooler colors are recommended on west or south exposures or in climates that are located in a climate that is predominantly warm (Pile, 1997; *Time*, 1946).

With sustainable and green building and design being a dominant issue in the United States today, lowering energy costs are a governing focus in school design and planning. Colored walls are also recommended for classroom walls to save on energy costs in school facilities. The use of colored walls in a classroom can actually alter a person's physical perception of the temperature in a room and allow the setting of heating and cooling temperatures to be reduced or increased accordingly (Cottreau, n.d.). By using warm colors, the classroom can appear six to ten degrees warmer than it actually is and six to ten degrees cooler with the use of cooler colors. This reduction or increase in temperature perception allows less energy to be used for thermal comfort achievement and results in less energy consumption and lower acquired energy costs (Cottreau, n.d.). Colored walls used in conjunction with complementary lighting types are also a strong team used to save on energy costs due to reflectance values emitted. As of 2010, the US Energy Information Administration (EIA) estimates that 13.5% of the United States total electricity consumption was from lighting alone (EIA, 2011).

Since the 1990's, design-based learning theories have become prevalent since the 1990's, which bring research and practice together. A. Brown and A. Collins brought this design-based theory into existence. What works in the real world, in lieu of the laboratory, should be dominant in learning situations to promote enriched learning. Some of these design experiments on design research of educational facilities were conceived to communicate relevant design solutions to practitioners and educational design professionals. This design based learning theory relates to this study in that it promotes a more realistic and enriched learning environment provided by color. When the colors of the "real world" are stripped from classroom environments, students are placed in a sterile, man-made, white

environment devoid of the psychological benefits of color. In this same sterile classroom environment that is most commonly used where our students learn, real-world color is replaced by dominant values of white on all surrounding wall and ceiling surfaces.

Considering this further, where in nature can an environment of total values of white be found? Winter months in colder climates with adequate snowfall are representative of this whiteness, but even then, the ceiling or the sky has sunshine and bright hues of blue that break up the monotony of the white blankets of snow on the ground. Here the white is on the flooring and on some decorative aspects such as trees and buildings, but is not on the walls that surrounds the person. The viewer can still see other entities in nature that have hues of color organically present.

EDUCATING OUR EDUCATORS

Over the past 100 years, the use of color in classrooms has been and continues to be promoted and advocated in numerous articles, books, design conference presentations, case studies, and the like. Sadly, only a small percentage of schools actually adhere to the recommendations for using colored walls in classrooms. "Consequently, the {physical} environment mistakenly became a little regarded factor in the learning process. During the period 1950 to present, there has evolved a growing body of literature that suggests a much stronger relationship" (Moore, 1991, p. 16). The key to any type of change or advancement in learning is being exposed to the knowledge. "Educators have not been in the forefront of research dealing with the relationship between behavior and {physical learning} environment" (Moore, 1991, p. 83). School design and planning continues to advance through innovations in technology that directly impact energy with the increased usage of sustainable classroom products; however, when it comes to the predominant use of colored classroom walls as a strategy to achieve lowered energy consumption in classroom design, change has been reluctant to take place (Pearlman, 2010). Despite all the studies showing the benefits of colored walls, traditional white values continue to be used.

With so many references on classroom design and the psychological impacts of color readily available, why is it that only a handful of these resources give any type of direction to owners' representatives of schools on how to implement proper color use within classroom settings? The available resources are more geared toward exposing professionals on why color is beneficial to learning and provide a general overview of how color works psychologically in general terms of color theory, but often do not give specific recommendations on how to achieve a given desired result for a specific school. "Currently, few resources are available to help guide teams wanting to learn how best to manage such a design process – or even where to begin" (Lippman, 2010, p. 15). Possibly, the lack of specific resources exists because all school facilities have different learning objectives and located in various regions of the country; and that emphasis and trust is placed from the school representatives with the design team or architect professional to educate them on their available options. In order to achieve the positive impacts provided by successful, evidence based color schemes in schools, facilities may need to consult a professional who specializes in the use of color in the design of school interiors. Although this is a positive step, many educators do not realize what properly selected classroom wall color can do for the promotion of learning and behavior according to the review of the related literature. Moreover, the benefits of using color (as selected by a color professional) to students and educators seems to be considered an unnecessary luxury item that the majority of educa-

tional facilities think they cannot afford or more likely, do not even know exists. With almost three and a half centuries of knowledge that shows how powerful and beneficial color is to humankind, white continues to be utilized as the traditional safe choice for walls in our classrooms. The proven and enduring fact is that humans need sensory variety; and sensory variety is provided by actual color hues. Minimal progression in implementing color in our classrooms has been accomplished by means of furnishings and other finishes, however, these items ultimately fail to create an enriched learning environment due to the smaller amount of color distribution they give off when compared to the walls.

Unfortunately, white walls have continued to dominate in educational facilities and remain as constant representatives for our academic downfall in our classrooms today. Without the architectural design team having the same type of color knowledge needed to support and recommend the use of color to promote an enriched learning environment, it seems inevitable that the traditional white selections for classroom walls will remain as a constant deterrent to the benefits of colored walls that can be reaped by the space's occupants. Without a school's owner representative being knowledgeable about the educational benefits of color and actually requiring color variety to be part of the written architectural specifications, odds are that they will receive the recommendation of a traditional selection in a range of white values on their classroom walls. Not utilizing our color research for its potential for prosperous achievement in our classrooms because of ignorance, or resistance to change, or perpetual tradition is an unnecessary adversity between the objectives of the nation's educational system and the potential outcomes available for learning performance and morale of our students and educators. It is apparent that bridging this disconnect can help to better our quality of education. The question is: How do we construct the bridge?

REFERENCES

Air Force Center for Engineering and the Environment (AFCEE). (1999, November). *Interior Color Selection.* In Air Force Center for Engineering and the Environment, *Air Force Interior Design Guides.*

Barnes, R. (2010, April 01). CM-at-Risk on Infrastructure: Building Consensus. *Texas Construction.*

Birren, F. (1950/1961). *Color psychology and color therapy: A factual study of the influence of color on human life.* Secaucus, N. J.: The Citadel Press

Boston Latin School Community Essays (2012). *Reflections on Alma Mater*. Retrieved March 27, 2012 from http://www.bls.org/history?rc=0

Chamberlain, L. M., & Kindred, L. W. (1958). *The teacher and school organization*. (3rd ed.) Englewood Cliffs, NJ: Prentice-Hall.

Chase, S. B. (n.d.) *Painting historic interiors*. National Park Service (NPS) US Department of the Interior. Retrieved January 10, 2011 from http://www.nps.gov/hps/tps/briefs/brief28.htm

Cheskin, L. (1947). *Colors: What they can do for you*. NY: Liveright Publishing.

Cottreau, A. (n.d.) *Colour design for better classrooms*. Canadian Adventist Teachers Network.

De Botton (2007). *The architecture of happiness.* London, England: Penguin Books.

Education Color in the Classroom (1946, May 13). *Time.*

Emory College Classroom Working Group and Campus Services (2010, October). *Emory College classroom design guide.* Retrieved September 30, 2011, from http://college.emory.edu/home/assets/documents/facilities/classroomGuidelines.pdf

Englebrecht, K. (2003, June 18). *The impact of color on learning*. Presented at NeoCon, Chicago, IL.

Fielding, R. (2006, December). Learning, lighting, and color. *DesignShare*.

Grangaard, E. (1993). *The effect of color and light on selected elementary school students.* Doctoral Dissertation, University of Nevada, Las Vegas. Reproduced by US Department of Education, Office of Educational Research and Improvement.

Hurst, G. H. (1900). *Colour: A handbook of the theory of colour*. London: Scott, Greenwood.

Interstate school building service, George Peabody College (1929). *For better schoolhouses*. Nashville, Tenn.: Author.

Kahiwagi, D. (2010, August). Bond Programs: Accountability and Best Value. *DesignShare August 2010 e-Newsletter.*

King-Tut Organization of the United Kingdom (n.d.). *The ancient Egyptian home.* Retrieved from http://www.king-tut.org.uk/ancient-egyptians/ancient-egyptian-home.htm

Küller, R. (1981). *Non-visual effects of light and colour.* Document D15:81, Stockholm: Swedish Council for Building Research.

LePatner, B. B. (2008, January 23). The Industry That Time Forgot. What's wrong with the $1 trillion construction business? *The Information Technology & Innovation Foundation*.

Lippman, P. (2010). *Evidence-Based Design of Elementary and Secondary Schools: A Responsive Approach to Creating Learning Environments*. New York, NY: John Wiley & Sons, Inc.

Mahnke, F. H. (1996). *Color environment, and human response: An interdisciplinary understanding of color and its use as a beneficial element in the design of the architectural environment.* New York, NY: John Wiley & Sons, Inc.

Moore, D. (Ed.). 1991. *Guide for Planning Educational Facilities*. Columbus, OH: Council of Educational Facilities Planners, International.

Pearlman, B. (2010). Designing new learning environments to support 21st century skills. In J.

Bellanca, & R. Brandt, *21st century skills*. Bloomington, IN: Solution Tree Press. (p.116-147)

Pierman, B. C. (1978). *Color in the health care environment.* Proceedings of a special workshop at the National Bureau of Standards, Gaithersburg, Maryland, November 16, 1976. Washington, D.C.: U.S. Department of Commerce, National Bureau of Standards: for sale by the Supt. of Docs., U.S. Govt. Print. Off.

Pilaroscia, J. (2010, January, 13). *Color and the learning environment*. (Web log comment). Retrieved from http://colourstudioinc.blogspot.com/2010/01/color-and-learning-environment.html

Pile, J. (1997). *Color in interior design*. New York: McGraw Hill.

Say yellow to colour. (2008, January 18) *TES Magazine*.

Schumacher, L. (2003, July). Common causes of cost growth during construction. *Pinnacle One*.

Sherwin Williams. (2011). *Graduate to color*. Retrieved September 23, 2011 from http://www.sherwinwilliams.com/pro/paint_colors/about_color/working_with_color/graduate/

Stark, S. (n.d.) The great divide – what happened to colours in 1900? *Old House Colors.*

Tell City Electric Department (August 15, 2006). *History*. Retrieved March 27, 2012 from http://www.tellcityelectric.com/history.htm

The Old Fashioned Milk Paint Company (n.d.). *The history of milk paint.* Retrieved January, 10, 2012 from http://www.milkpaint.com/about_history.html

Twain, M. (1876). *The adventures of Tom Sawyer*. New York and London: Harper and Brothers.

U.S. Department of Education (USDOE). (2011). *What we do*. Retrieved October 26, 2011 from http://www2.ed.gov/about/what-we-do.html

U.S. Energy Information Administration (EIA) (2011) .*How much electricity is used for lighting in the United States?* Retrieved November 4, 2011, from http://www.eia.gov/tools/faqs/faq.cfm?id=99&t=3

Vodvarka, F. (1999). *Aspects of color*. Chicago, Il: Loyola University.

Wigley, M. (2001). *White walls, designer dresses: The fashioning of modern architecture.* Cambridge, MA: MIT Press.