Safety issues of children age 3-5 years in school classrooms: a perspective of classrooms in the United States

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Safety issues of children age 3–5 years in school classrooms: A perspective of classrooms in the United States

by

Weiqi Chu

A thesis submitted to the graduate faculty
in partial fulfillment of the requirements for the degree of

MASTER OF FINE ARTS

Major: Interior Design

Program of Study Committee:
Fred Malven, Major Professor
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Iowa State University
Ames, Iowa

2014

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DEDICATION

I dedicate this research project to my sisters and brothers for their unwavering support both spiritually and morally and for their great encouragement to see me succeed in my career and to my friends who greatly supported me during the entire duration of my studies; without them, the course would have been strenuous.
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ABSTRACT

Interior design is an established industry in the United States with its profits well known to be a good contribution to the national economic growth. Some effort has been made by U.S. Design Council to make sure that the interior design of buildings promotes good health and comfort. Questions have been raised about the safety of U.S. classrooms meant for elementary-level children, specifically those under than 5 years of age. This formed the basis of this research, which unraveled the separate interior design elements of elementary classrooms and their effects on pupils’ learning and health. Data were collected through secondary methods from various documentary materials that shed light on the interior design of classrooms and their effects on pupils’ development and learning capabilities. Data were then analyzed through an interpretive and comparative procedure of key variables such as classroom threats and learning achievements.

The findings showed that pupils in U.S. school classrooms face mainly seven kinds of classroom threats—thermal, chemical, mechanical, organic, electrical, physiological, and emotional threats—in varying degrees depending on the students’ gender and location. Generally, female pupils were found to be more greatly affected by thermal, emotional, and physiological threats than were their male counterparts in academic achievement. That is because, unlike females, male pupils tend to adapt quickly to classroom threats such as feeling extremely hot, fatigued or dizzy. Additionally, it was found that all pupils face multiple health challenges when exposed to the various above-mentioned threats in their classrooms.

With many U.S. schools requiring the use of pesticides, and the environment having been polluted through industrial processes, many children have been exposed to additional
chemical threats, leading to death due to diseases of the respiratory system, such as asthma and pneumonia, as well as other ailments such as skin cancer, brain cancer and retarded growth, to name just a few. It was recommended that schools, the state and parents work together for a safe learning environment for children 3–5 years of age. The study also recommended that interior designers should observe professional standards to reduce the prevalence of mechanical, chemical, electrical, organic and thermal threats, which were also some of the causes of emotional and physiological disturbance among pupils.
CHAPTER 1. INTRODUCTION

1.1 Introduction

This chapter provides background information about interior design in the world and in the United States. It also provides the essence of the study analysis, the research aim and objectives. In addition, the chapter describes the research questions, scope and purpose by specifically looking into preliminary matters on safety issues of children 3–5 years of age in school classrooms.

1.2 Study Background

1.2.1 Evolution of Interior Design

Interior design is as old as humankind is and can be traced back to the prehistoric period when humans lived in caves and designed the caves using primitive forms of drawings and paintings (Pile, 2005, p. 13). However, keen thought into interior design can be dated back to the Ancient Egyptians during the Dark Ages, when they used animal skins, painted vases, sculptures and murals to decorate their houses. Evidence of these decorations has been found in the ancient tombs of great Egyptians leaders such a King Tutankhamen (Pile, 2005). Pile (2005) asserted that there is great evidence of the existence of interior design from the ancient Egyptian civilization, as most of the ancient interiors have remained intact over time due to the availability of good quality stone from the Nile Valley, which the Egyptians used. Examples of great Egyptian design include the great pyramids, which date back to around 2800 B.C., and whose interior passages give great evidence of ancient Egyptian conceptual thinking and geometric planning in interior design (p. 25).

The ancient Egyptian interior designs were borrowed and adopted by the Roman and Greek civilizations, who built upon the Egyptian designs to develop their own interior design...
decoration, art and accessories. Interior design, to the Romans and Greek, symbolized comfort and beauty. Thus, the wealthy used interior design, art and accessories in their homes to reflect their high status in society (Pile, 2005). However, this period of ornamentation and splendor gave way to a period of austerity during which time there was reduced use of ornamentation and colors in interior design. People tended to use simple fabrics, muted colors and wall fabrics for their interior designs. This change was brought about because of the constant Medieval European wars as well as the rise of the Christian church (Pile, 2005).

After this period, during the 12th century, ornamentation and color were again brought back into interior design. During this period, the Europeans used Gothic styles, such as windows to capture the natural light, in the interior design of open spaces (Bernard, 1999). During the 15th and the 16th centuries, the French Renaissance brought changes to the way interior design was perceived. People started focusing on the beauty and art encompassing interior design. In constructing buildings, architects and designers began including decorative elements in their structures, for instance, inlaid woodwork, marble floors and furniture designs using the finest woods, as well as paintings (Pile, 2005). By the mid-18th century, the e-Rococo design style, which used decorative elements such as flower motifs, Asian porcelain and elegantly designed furniture using tortoise shell and mother of pearl, was adopted in Europe (Ulrich, 1990). Over the next 200-year period, various innovative designs came into and went out of fashion.

By the 20th century, the rise of new household commodities and appliances presented a new challenge to interior designers, who needed to plan spaces for functional and aesthetic purposes as well as address safety issues (Bernard, 1999). Over the years, the field of interior
design has developed into what it is today. Currently, designers have access to both synthetic and nonsynthetic materials to use in design. Moreover, as modern designers continually strive to create new design trends, they draw on the design influences of the past to ensure effectiveness in meeting functionality and aesthetics as well as keeping safety purposes in design.

1.2.2 Interior Design Today

Over the past decade, the world has been moving from a point where industrialization was at center stage for development to the current point at which development is a recipe for knowledge (Design Council, 2010). The economy of the world is now supported by information that has changed several sectors, including the design industry. In the design industry, design consultancy has been one of the most affected by the changes in the economy to a knowledge-based economy.

Interior design is one type of design that has been undergoing changes due to developments in knowledge. This is because of the concept of innovation encompassing the generation and use of new technology, which has extended interior design into a knowledge-based or knowledge-driven sector of the economy (Abdazi, 2007). Interior design, as defined by Pable (2009), is a profession that is multifaceted whereby solutions that are creative and technical in nature are applied so that a good interior environment can be built. Some of the basic features of the solutions applied include being functional, having the ability to display life quality, having an attractive aesthetic appeal, and promoting the culture of its occupants. The created interior design should be in response to the building and should be able to coordinate with the type of roofing, social context, and even the physical location of the building. Designs of professionally constructed buildings should adhere to the set legal and
code requirements and, in addition, should encourage the principles of environmental sustainability.

1.2.3 Safety and Interior Design

In terms of safety, interior design can be defined as a process that follows a coordinated and systematic method encompassing the analysis of research and incorporation of core information within an innovative process to ensure designs for indoor spaces of a wide array of buildings that are functional, aesthetic and safe (Guerin, 1991). Thus, one of the core factors determining effective interior design is how it ensures the safety of the people occupying such spaces. Piotrowski and Rogers (2010) asserted that it is imperative that interior designers understand how various safety issues relate to indoor space and air quality. The style of design in spaces and materials used in design need to be specified in such a manner that they promote a safe interior environment of a building.

Professional interior designers should enhance life through their designs. This implies that designs should not only take into account issues concerning interior decoration functionality but also should enhance the health and safety of people (Guerin, 1991). In order to meet this objective, Guerin and Martin (2010) have provided a body of knowledge, as defined by various interior design professional organizations, that needs to be taken into account while undertaking interior design. Apart from factors such as ensuring that the interior design meets the clients’ needs in terms of quality, cost, schedule and scope, other core factors primarily highlighted are those concerning the health and safety issues of the buildings being designed. For instance, one of the outlined tasks is the requirement to ensure that design concepts and space plans used are aesthetically appropriate and functional, and that they meet all the safety and health requirements in terms of sustainability issues,
environmental issues, safety code as well as accessibility. These concepts and designs need to adhere to fire codes as well as building regulation guidelines for interior spaces.

The various guidelines provide a body of knowledge for interior design, and the role interior design plays in the safety, health and welfare of people ensures that interior designers are able to see interior design as more than just creation of aesthetic value. From the guidelines, it can be noted that, although interior design aims to adjust and blend the spaces within the building location that will be used, it also ensures a safe environment for occupants.

Various studies have indeed linked interior design to safety issues within buildings. Guerin (1991) asserted that optimized work station design, building layouts, acoustical, lighting as well as environmental design strongly play a key role in preventing accidents from occurring. Optimized lighting design in this matter may include dimming circuits, developing light levers and dealing with reflections and glares, all of which eliminate eyestrain. Optimized safety and environmental conditions can include effective fire control and air conditions, all of which reduce accidents and risk. Optimized acoustics may include using certain ceiling, floor and wall materials that can minimize noise distractions, and an optimized room layout may include certain spacing, as well as information displays that minimize distractions (Guerin, 1991). All these design factors play an important role in the health, well-being and safety of persons using the rooms in question as well as improve the manner in which people are able to do their work. Bacon (2011) agreed with this viewpoint, noting that interior design plays an important role in elevating the quality of life by preventing all forms of harm.
1.2.4 Interior Design in Classrooms

Various research studies have pointed to the need to consider design factors when designing classrooms in elementary school, high school, and college environments. Hasell (1996) noted that teaching can be difficult and that for students to attain focused learning it is imperative that the learning environment be able to generate enthusiasm for the students, help students adapt to learning styles as well as encourage student interactions. For this to be possible, schools need to provide learning environments that are friendly, comfortable, and encourage creativity. Analyzing the rules of interior decoration in educational institutions, Keith (2011) asserted that classrooms need to emphasize the flexibility in interior decoration in order to support project-based learning environments. In order to motivate children to be creative in their school projects, the interior decoration needs to be fun and bright and include lively colors, as each aspect of the learning environment supports student learning in different ways and for different students. A recent report by Barrett, Zhang, Moffat and Kobbacy (2013) found that classroom interior design could affect a student’s performance by as much as 25%. Core aspects evaluated included factors such as acoustics, classroom orientation, temperature, natural light, flexibility, indoor air quality, color and organization (Bacon, 2011).

Tremblay, Peng, Kruel-Froseth and Dunbar (1999) had a similar viewpoint, arguing that the interior design of a classroom affects student learning. In their study, the authors argued that, as education technology and environment continually change, it is imperative that interior design also shift to encourage ease of technology use to support learning. This may include the design of online learning environments or online student interactions, smaller class sizes, and arrangement of the school furniture, among others. Effectively
allocating resources to various design factors is imperative to ensure that students are able to have a more comfortable learning environment that enhances student learning as well as protects students.

Classroom design has physiological impacts on a student’s experience learning. Core interior design aspects that need to be taken into consideration include factors such as wall colors, natural light and personalized student decorations, such as having student paintings on the wall. Other core factors include temperature levels, desk design, classroom size, activity centers within the classroom as well as noise levels in the class. Considering these factors is imperative in ensuring optimal outcomes for the students. Tremblay et al. (1999) asserted that effective design of under-floor air distribution and ventilation systems plays a crucial role in effective control of temperature of indoor spaces. This is imperative in controlling the supply of warm and cold air to the occupied spaces within a classroom, which in turn ensures the students’ comfort within the learning environment, as well as ensuring a cleaner indoor environment.

In addition to ensuring student comfort, the design of the classroom environment should be accomplished in such a manner that these elements are easy to use, even for people with disabilities, and designers need to make sure that safety precautions, such as ensuring that the interior decoration uses fire safe fabrics and materials, are taken into consideration. For instance, Lazo-Flores (2012) examined classroom interior design factors that need to be taken into consideration for hearing-impaired students in order to ensure both safety and accessibility for these students. With regard to lighting, reflections, weak lighting and glares were noted to provide poor visibility for the teachers and thus provided an ineffective learning environment in terms of accessibility. Also with regard to acoustics, the findings
showed that, because hearing-impaired students tend to be noisy, coating materials needed to be used so that sound is absorbed, because if sound isn’t absorbed, not only would the students’ auditory capabilities be hindered, but this could also lead to ineffective safety, especially when students need to be alerted and communicated with through reverberation of sounds. Another factor that has to take into account is classroom layout design, as hearing-impaired students are highly visual beings and, thus, the placement of the furniture needs to be in such a manner that each student is able to have a view of the teacher as well as the classroom entrance. The distribution of furniture provides security for these students and helps in preventing harm (Lazo-Flores, 2012).

Designing a learning environment for younger children presents an even greater challenge, as young children tend to be curious and change their behaviors quickly. Thus, safety and threat issues for younger children tend to be more pronounced than they are for older children. Pable (2009) argued that, although there may not be a universal way of dealing with changing behaviors of young children, a number of strategies can be undertaken to ensure that the children are safe and not negatively impacted within their learning environments. These strategies include implementing routines, rules and rituals; scheduling classroom activities; and finally and most important to this study, arranging the classroom in such a manner that there are minimal accidents that can occur within the learning environment.

How preschool classrooms are designed can play a crucial role in dealing with a number of safety and threat issues that young children may face in their learning environment. This research study sought to investigate and understand how this can be achieved. Children are likely to face seven major safety and threat issues within classrooms:
mechanical, physiological, chemical, emotional, thermal, organic and electric threats (Cotterell, 1984). Cotterell (1984), in his investigation of these safety and threat issues, noted that mechanical safety issues might involve injuries due to individuals coming into contact with hard surfaces or objects, for instance falling or being struck with an object. Thermal safety issues are those caused by coming into contact with heat, for instance fire, hot air or hot objects. Electrical threats or safety issues are those caused by electrical shocks, and chemical threats or safety issues are caused by coming into contact with chemical substances that tend to be hazards not easily identified, such as irritation due to a substance, corrosive effects, allergies or toxicities of substances used in classroom. Organic threats or safety issues, on the other hand, are concerned mainly with being exposed to harmful organisms, for instance those that transmit infectious diseases, such as the common cold, or unsanitary conditions. Physiological threats or safety issues may cause physical injuries such as muscle strains due to using excessive force or maladjusted sitting positions. Finally, emotional threats and safety issues may result from exposure to adverse conditions and stressful environments and which are affected by physiological issues (Cotterell, 1984).

Interactions between people and their environment are unavoidable and often spontaneous. Although an interaction may be positive or negative, how an interior space is designed may determine the degree to which it is positive or negative. A good design for the interior space of a classroom has to take into account all the environmental, physical and cognitive factors that impact individuals’ interaction with their environment and, thus, harmonize this to make it a space that enhances interaction, making it effective and efficient emotionally, aesthetically and functionally (Hoerwagen, 1990). This implies that the most
important factor to take into consideration when designing an interior space is the user of that space.

Understanding how interior design can reduce these threats and safety issues for young children is imperative in creating an environment for younger children that is conducive for learning and minimizes negative outcomes due to other external factors. Ulrich (1990) investigated core design elements for preschoolers 4–5 years of age. Core design elements within the classrooms noted in most kindergartens and early childhood centers include larger classrooms for enough space and paired rooms, which have folding walls for ease of expanding into a larger space. Furthermore, the floor tends to be made of weather-resistant materials, most having carpeting in play areas. The classes also contain cabinetry for keeping teaching materials, with drawer corners smoothly rounded for safety. Furthermore, unlike grade school classrooms, classrooms for younger children tend to have single self-contained toilets within each classroom for ease of use by the children. The displays on the wall tend to be colorful, fun and welcoming for the young children to reduce anxiety for those separated from their parents for the first time. The windows are wide and expansive to give an illusion of wider rooms. However, the windows also tend to have solar shades to protect the room from weather elements and control how much light gets into the classroom. (Ulrich 1990)

Core physical factors of interior design that interact with a child’s attitude and emotional state within a classroom are color, texture and material forms within the environment. Because the interior tends to be surrounded by color, the color throughout the interior of a building tends to be different from colors used elsewhere. Hadjiyanni and Jain (2009) asserted that interior color in interior design has the most mysterious and affective
influence on a person. Colors have the ability to arouse different emotions and reactions within a person. Hoerwagen (1990) argued that, although initially a reaction to an interior space color may be physiological and emotional, it tends to translate itself into physiological forms affecting mood, for instance. Reactions to color are dependent on both culture and a person’s individual preferences. Thus, for an interior designer, good taste alone is not adequate to ensure that the optimal interior design impact is attained. This is especially the case in view of the fact that young children tend to be diverse. Pile (2005) asserted that the choice of color used in the interiors of buildings tends to be dominated by cool, warm or neutral tones and is influenced by the region, climate conditions, activities done in the room, orientation and the preferences of the users. Ulrich (1990) noted that brighter, warm colors tend to be appealing to younger children’s happier and imaginative moods. Hoerwagen (1990) concurred, noting that the color of an interior surface tends to be dynamic energy that provides a different feeling when placed in different areas within an interior of a building. For instance, a red color on the ceiling may be associated with disturbance or intrusion, whereas red on the floor may make one highly alert and conscious. Warm colors are preferred in classrooms as they give a feeling of comfort and safety.

Texture comprises the materials that make up the interior of the room. Effective choice of materials plays a critical role in determining the experience within a room. Hoppen, Batten, Chislett and Etchedgui (2000) argued that different varieties of texture, such as stone, steel, suede, Perspex or velvet, can be combined to give a room a stunning effect. However, these have to combined and balanced effectively with color to provide a harmonious effect. In a classroom, especially one for younger children, the use of softer textural materials and carpeting is imperative to prevent injuries. Furthermore, the use of lead-free plastic learning
toys or tools within a classroom for younger children is imperative to ensure the children are protected from both physical and chemical harms. Abdazi (2007) noted that smooth surfaces tend to reflect light and those that are rough absorb light. The excess reflected light may result in a loss of surface definition, which can potentially result in slips and falls. It is thus imperative to create a balance between textured surfaces and lighting in the room. Adding some visual forms within a room also gives a sense of harmony and balance, which can also provide a sense of stability. For instance, adding a couch in a room gives a sense of stability. In a child’s classroom, this may also include bright-colored cabinetry with play toys or drawing materials. Having a large immobile toy can also provide a sense of stability.

Other interior design factors, such as lighting and sound, also play a strong role in determining the effectiveness of the interior of a classroom. Hoppen et al. (2000) asserted that proper lighting makes it possible to perform tasks easily and enables a person to feel comfortable and safe being in a room. Although every room has its own unique lighting needs, for a preschool classroom, having a well-lit room, especially using natural light, is imperative to enable good student attention in class. Webb (2006) noted that lighting within a room, especially natural light such as sunlight, has a strong impact on the physiological processes of humans. Natural light tends to influence and control the secretion of certain hormones as well as body temperature, which has implications for wake and sleep states and mood changes as well as the ability to be alert. Thus, a classroom needs to have well designed openings that control and enable natural light to come in.

Although these design elements have been investigated, no research has investigated what role various interior design elements in preschool and kindergarten classrooms play in
reducing various safety and threat issues as mentioned above. This research study sought to fill this gap in research.

As will be discussed in this thesis, the threats and safety issues children 3–5 years of age face are different in nature than those faced by those in other age groups, and these younger children are much more susceptible to such threats due to their young age and the curiosity that comes with it. However, interior design can play a significant role in minimizing such threats. For instance, based on Pable’s (2009) recommendations to rearrange internal classroom environments to deal with children’s changing behaviors, in this study it was hypothesized that such arrangements can also potentially minimize mechanical, emotional and physiological threats by enhancing interactions among students and also with their teacher as well as providing a bright and warm learning environment that captures the students’ attention. Other factors that can minimize physical and mechanical threats include monitoring children’s behavior as well as limiting the number of children per teacher in a classroom. Effective storage areas, as well as effective transition of learning materials, can also prevent chemical and mechanical threats, whereas factors such as lighting, temperature and the manner in which the electrical lines have been designed play a critical role in lowering thermal and electrical threats and safety issues. This research study thus sought to investigate these issues by analyzing how interior design helps in remedying the various safety threats children face within their classroom environment.

1.3 Problem Statement

Interior design was defined by Pable (2009) as a profession that is multifaceted and in which solutions that are creative and technical in nature are applied so that a good interior environment can be built. Some of the basic features of the solutions applied include being
functional, having ability to enhance quality of life, having an attractive aesthetic appeal and promoting the culture of its occupants. The created interior design should be in harmony with the building and should be able to coordinate with the type of roofing, social context and even the physical location of the building. The design of professionally constructed buildings should adhere to code and regulatory requirements and should encourage the principles of environmental sustainability.

The construction of classrooms for children must adhere to the above conditions as well. However, designers do not always meet the requirement of creating a sustainable environment for children in their classrooms due to the lack of knowledge of the threats in classrooms and of the safety measures needed to be undertaken. Therefore, this study is important because it can provide such information, which can be used to impart knowledge to designers, which in turn will enable them to design classrooms that are sustainable for 3- to 5-year-old children.

According to the Design Council (2006), the interior design industry, like many other industries in the world, is complex. Although this project aimed to identify the threats that interior design practitioners should be wary of during the construction of classrooms for 3- to 5-year-old children, there is still the need to link this with commercial interior design to ensure that this process is not costly either for the client or for the interior designers. What are needed are interior designers who have knowledge of medically healthy environments as well as high-end technology.

Interior designers therefore need to collect knowledge from different sectors of the industry through some form of designer “segmentation study” that examines the qualities and skills required across the different designer specialties. This could help educate designers and
clients so they understand better how to bring clarity and focus to understanding the skill requirements needed for the future. This study therefore is needed to provide information on the safety measures that need to be understood and undertaken during the interior design of classrooms for students who are 3–5 years of age.

1.4 Study Purpose

The reason for conducting this study was to determine safety measures that need to be undertaken in the interior design of classrooms for children between 3 and 5 years of age. This study employed qualitative research methods to determine the safety measures in designing the interior of classrooms for children in this age group. This qualitative study involved sources who were key informants for the study.

1.5 Significance of the Study

Rather than looking at design as a homogeneous whole, this research looked at components of design in considering interior design safety measures in classrooms. This research gives direction on which future scenarios will emerge in the sector of interior design. Given this premise, policy development focused on supporting and/or nurturing those safety measures that are proposed in this study to ensure that there their purpose is appropriate, and therefore, they are used to develop guidelines for the interior design of classrooms. The findings from this study will also be used by teachers in early childhood development settings to ensure that the children are safe whenever they are in class and that they are not exposed to any form of threat within the classroom. Finally, the information from this study adds much-needed literature to the field of interior design that can be used by other researchers who are interested in this field of study.
1.6 Objectives

The main study objective was to determine what safety measures interior designers should be consider in the building and design of classroom interiors for children 3–5 years of age. The research had the following specific objectives:

1. To determine the threats faced by children 3–5 years of age in their classrooms;
2. To identify how such threats affect children’s learning in schools;
3. To identify the various safety measures that can be considered during the interior design of the classrooms to minimize the exposure of the children to such threats;
4. To propose policy recommendations to ensure the safety of children classrooms.

1.7 Research Questions

The following research questions guided the study:

1. What are the threats faced by children 3-5 years of age in their classrooms?
2. How do such threats affect children’s learning in schools?
3. What are the necessary safety measures that can be undertaken during the interior design of the classrooms to minimize the exposure of the children to such threats?
4. What are some of the policy measures that will ensure safety in children’s classrooms?

1.8 Scope, Assumptions and Limitations of the Study

Given that this study focused primarily on secondary data, it was assumed that there would be enough materials and sources of information for all the relevant research. The limitation of this research was researcher bias and perceptual misrepresentations that may have occurred during this qualitative study.
1.9 Definitions of Terms

Interior design: For the purposes of this study, the definition of the term interior design was modified from the definition provided by the NCIDQ (National Council of Interior Design Qualification, 2004). According to NCIDQ, interior design is focused mainly on the process of building, decorating and applying aesthetics to the interior environment of buildings (in this case, classrooms meant for children 3–5 years old). Interior design is multifaceted in that the designer should coordinate and harmonize creative and technical concepts to come up with an appealing interior for different contexts and purposes. Thus, NCIDQ argued that interior design must be considerate of regulatory requirements, set standards, procedures and codes of conduct and environmental sustainability standards. As professionals, interior designers therefore follow a systematic process and procedures starting from conceptual research, to analysis and, finally, to integrating knowledge into the creative and technical processes.

Classroom: A classroom is a setting (inside a building or any structure) where classes are held or conducted. For the purpose of this study, a classroom is an interior environment where learning for children 3–5 years old takes place.

1.10 Nature and Order of Presentation

This study consists of five chapters. Chapter 1 provides the background information of the study, the statement of the problem being studied, the purpose of the study and the objectives and the research questions that guided the study. This chapter also defines the scope and limits of the study and the terms used in the study.
Chapter 2 presents the general theory of school safety. It gives insight into the threats faced by children 3–5 years of age in their classrooms as well as empirical evidence of the safety measures that should be undertaken to limit their exposure to such threats. Chapter 3 narrates the research on childhood school safety. Chapter 4 provides a discussion about school safety and the threats faced by children 3–5 years of age in their classrooms. Chapter 5 presents the analysis of one preschool classroom and offers some solutions that address the safety problems.

1.11 Summary

In summary, this chapter has provided a background to the dissertation about safety issues of children aged 3-5 years in school classrooms. Seven main types of classroom threats have been identified and will be discussed as the focus of the entire study. These threats include thermal, mechanical, electrical, emotional, chemical, organic and physiological threats. More light is shed on these threats in subsequent chapters.
CHAPTER 2. GENERAL THEORY OF SCHOOL SAFETY

2.1 Introduction

In this chapter, literature from various scholars on the domain of safety issues for children 3–5 years of age in school classrooms is reviewed. To this end, this chapter covers various aspects of this topic, including threats faced in school classrooms by children this age, identification of how these threats affect children’s learning in schools and identification of an array of safety measures that can be taken during the interior design of a classroom to lower the exposure of children to the identified threats. Finally, this chapter also includes a discussion of safety theories and proposes various policy recommendations that will ensure the safety of children in classrooms (Robert, 1995).

2.2 Threats Faced by 3- to 5-Year-Old in School Classrooms

Studies on threats in buildings have revealed that seven categories of threats or combination of threats characterize safety problems within a building (Zhu & Wang, 2012). These threats include: chemical threats, mechanical threats, electrical threats, organic threats, physiological threats, emotional threats and thermal or radiation threats. According to Meggs, Greer and Collins (2012), these threats were identified based on classification of factors that identified links between several subcategories of injuries that are related to hazards in the interior of a building. Many of these hazards could be eliminated through proper interior design.

Nationally, in a typical year, over 50,000 people are killed in building-related accidents and millions more are often permanently injured in the United States, according to statistics from the U.S. Department of Housing and Urban Development (HUD; Miller-Cochran & Gierdowski, 2013). The cause of many of these deaths and injuries is that most
designers are not aware of the threats the users of their buildings face. According to Keith (2011) children in schools today are exposed to a myriad of threats as they learn in their classrooms mainly because of poorly planned and constructed classrooms that are not ideal for learning. As further outlined by Chabbott (2004), for a classroom to be classified as healthy, it should be where learners as well as teachers work together in a continuous process to shield and uphold the health, safety and well-being of all learners.

Classifying the threats facing 3- to 5-year-olds in school classrooms, Chabbott (2004) posited that there are seven threats that are common in classrooms around the globe, including mechanical, electrical, chemical, organic, physiological, thermal/radiation and emotional threats. As outlined by Keith (2011) these threats were identified based on factors that were detected and linked to various subcategory injuries that could be connected to hazards found in building interiors. These hazards or threats can be eliminated by implementing proper and professional interior design approaches during the construction of classrooms, as well as other rooms and buildings; issues such as proper wiring, ventilation and lighting, among others, should be given the utmost consideration.

### 2.3 Threats to School Performance

One of the threats to pupils is poor academic performance because of the interior design of their classrooms. The design relates to aspects ranging from the number of displays, colors, arrangement styles, paints and furniture used as well as the location of classrooms and others. Studies have successfully linked poor performance among pupils 3–5 years of age to poor classroom design.

According to Zhu and Wang (2012), in a study conducted earlier 2012 by the University of Salford, researchers in the School of the Built Environment discovered that the
interior design of classrooms either diminished or multiplied pupils’ performance academically and socially in equal proportions. Data from 34 classrooms with 751 pupils, all from England and Blackpool in at least seven primary and elementary schools, were used in this study. In the research, all the pupils from whom results were obtained were spread evenly across the seven primary schools and across gender and allowed to spend 50 to 80% of their time in classrooms set up for the purpose of the study (Zhu & Wang, 2012). The set-up classrooms were subjected to various kinds of poor interior design that could be related to the pupils’ performance. Teachers were then allowed to instruct the pupils as usual. One aspect for which this task was well suited was the test to ascertain student achievement as it related to different interior design aspects. Students in both experimental design environment and those in the control environment were subjected to the same aptitude tests in numerical (mathematics), writing, speaking and reading abilities. The results clearly showed that when pupils were placed in the best classrooms as opposed to the worst there was great improvement of more than 11 points in the period of one year. A summary of other results obtained from the survey on the impacts of the basic design factors on pupil’s performance, as obtained from Meggs et al. (2012), are shown in Table 2.1.

It can be summarized that air quality and texture formed a portion of the most important of the 10 elements of study (i.e. sound, temperature, air quality, light, flexibility, connection, choice and color) in terms of their effect on pupil performance. Although quite insignificant in terms of their effect on the performance of the pupils, air quality and texture are two of the components that students do not easily recognize in their environment. However, the potential for these two aspects have a negative impact is still high, as the study did not give these much attention.
Table 2.1 Basic Design Factors and Their Effects on Pupils’ Performance

Color, complexity, flexibility, air quality and sound are the key factors that affect the learning process in classrooms.

<table>
<thead>
<tr>
<th>Design Parameter</th>
<th>Indicators</th>
<th>Effect on Learning Progression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>Appropriate colors on walls, floors, and furniture; warmer for younger students (supporting extroversion) and cooler for older students (supporting concentration)</td>
<td>Strongly positive</td>
</tr>
<tr>
<td>Choice</td>
<td>“This is our classroom!” — a sense of ownership and use of comfortable and familiar furniture</td>
<td>Positive</td>
</tr>
<tr>
<td>Connection</td>
<td>Clear and orienting corridors; quick access to classrooms and connections with other spaces; wide and clear pathways</td>
<td>Strongly negative, i.e., an increase in this factor led to a decrease in learning progression. Surprised with the result, the authors note that this factor is clearly important but not well understood.</td>
</tr>
<tr>
<td>Complexity</td>
<td>Greater site and building area, and novelty of surroundings; interior décor that catches attention, in balance with orderliness</td>
<td>Strongly positive</td>
</tr>
<tr>
<td>Flexibility</td>
<td>Adequate space for students; attractive learning space, configurable for varied learning activities</td>
<td>Strongly positive</td>
</tr>
<tr>
<td>Light</td>
<td>Quality and quantity of natural light, and degree of control</td>
<td>Positive</td>
</tr>
<tr>
<td>Texture</td>
<td>Availability of distant and close views through the windows, area to play outside, and outdoor learning alternatives</td>
<td>Initially found to be individually significant at the 10% level, but in a statistical model they were closely correlated with other factors and not found to be significant, possibly because of low variability among classrooms.</td>
</tr>
<tr>
<td>Air Quality</td>
<td>Level of contaminants such as carbon dioxide, and availability of controls</td>
<td>Initiallly found to be individually significant at the 5% level, but in a statistical model they were closely correlated with other factors and not found to be significant, possibly because of low variability among classrooms.</td>
</tr>
<tr>
<td>Temperature</td>
<td>Comfort level in summer and winter, and quality of heating distribution and control</td>
<td>Initially found to be individually significant at the 10% level, but in a statistical model they were closely correlated with other factors and not found to be significant, possibly because of low variability among classrooms.</td>
</tr>
<tr>
<td>Sound</td>
<td>Frequency of disturbance, and the degree to which teachers can be heard</td>
<td></td>
</tr>
</tbody>
</table>

Source: Meggs et al., 2012.

In normal terms, temperature is defined as the degree of how hot or cold a substance (in this case the classroom) is. Being a physical quantity, temperature can be expressed in numerical values (i.e., degrees Celsius, Kelvin or Fahrenheit) when measured using a thermometer. Temperature usually measures the thermal energy of air particles or radiation. When classrooms designed for pupils have weak thermoregulation, this is likely to hinder pupils’ best performance. It is very easy for pupils to detect a change in temperature. An
interior that allows for easy fluctuation of temperature in a classroom meant for 3- to 5-year-old pupils is not ideal. A good classroom, according to Bullock and Foster-Harrison (1997), should be able to keep the temperature at a constant level whether it is winter or summer or the day is chilly or hot.

Pupils exposed to extreme temperatures in classrooms, in addition to performing poorly in class, are also exposed to other dangers. For instance, a room temperature that is too low can lead to respiratory disorders, poor blood flow, and the chills. Poor concentration and stunted growth of body tissues is another effect of extremely cold conditions. Whichever the type of extreme temperature, Zhu and Wang (2012) argued that 3- to 5-year-old pupils are more likely to suffer than are their older pupil counterparts.

Color is described as how vivid a visual appearance is resulting from the presence of brightly colored objects (Day, 1999). In many physiological studies, color is defined as a perceptual visual property that corresponds to the humans’ vision for red, yellow, blue or green. Perception of color occurs among humans only when the spectrum of light interacts with the eyes. Different materials are also associated with different colors based on how they reflect, absorb or emit the light spectra. The color of a classroom is not easily changed unlike temperature, for example, which can be changed by opening a window when it is very hot. Color, as argued by Patton, Snell, Knight and Gerken (2001), accounts for many variations in the performance of students and remains a big threat if not well monitored through interior design.

Poor color choice for the interior of children’s classes has a number of threats associated with it. One risk is the loss of (or weakening of) the pupils’ eyesight. Interaction with luminous and warm colors beyond a recommended duration is capable of causing eye
problems. Moreover, when many colors rapid interchange in the presence of the pupils, their eyesight is likely to weaken because of the interaction of the retina with the pupil of the eye, sensitive eye organs that enable vision and perception. Furthermore, complexity, light, color, choice and connection are all significant in determining the performance of a pupil (Meggs et al., 2012). As a result, without proper choice of design elements, pupils may continue suffering in their classrooms. Unfortunately, many classroom workers know of these dangers but take action reluctantly because they do not have any other recourse.

An important aspect that must be checked is the standardization of design elements in the construction of children’s facilities. Statistically, more than 18% of all pupils attending their first classes in the United States develop new problems and ailments immediately after they join the classes (Sheffler, 2009). Many of the ailments and problems are avoidable and preventable through good interior design of the classrooms. A number of scholars have debated about best practices in interior design of classrooms for children under the age of five years; this is explained in the next section in relation to the chemical, mechanical, electrical, organic, physiological, emotional and thermal/radiation threats.

2.4 Threats in Classroom Buildings

According to statistics from HUD, more than 50,000 deaths and millions of permanent injuries related to accidents in buildings occur every year (Miller-Cochran & Gierdowski, 2013). This is because most designers are not aware of the threats that users of their buildings face. A healthy classroom is defined as one in which the pupils and the teachers collaborate in a constant process of improvement aimed at promoting the health, well-being and safety of pupils (WHO, 2010). Accordingly, healthy classrooms should be
open, accessible and accepting environments for pupils with differing backgrounds, demographics, skills and abilities.

In a study on the threats in buildings, Ulrich (1990) identified seven interior design threat categories that can describe the safety problems within a building. These threats include: chemical threats, mechanical threats, electrical threats, organic threats, physiological threats, emotional threats and thermal or radiation threats.

2.4.1 Mechanical Threats

According to Abdazi (2007), mechanical threats are the most common threats in buildings around the world and are usually caused by material objects such as doors and falling ceilings and windowpanes, among others. These threats, which can be responsible for injuries, are usually environmental elements that are visible to the victims and cause immediate pain to the victims. As postulated by Colome et al (2004), mechanical injuries also can be described as unintentional contact with objects or surfaces in the environment that result in either blunt pain, scrapes, piercing abrasions or other bodily impairment.

Furthermore, Abdazi (2007) stated that most of the mechanical threats in classes are a result of one or a combination of the following: a child falling onto or from an element, for example a staircase, railing or wall sink, among other injurious objects; second, a child striking an element such as a protruding door handle, edge of a window, a projecting drinking water fountain or the edge of a classroom door, among others; third, a child being struck by an element, such as a falling book cabinet, falling ceiling; fourth, a child being injured because of compression by an element, such as a child’s fingers being pinched in a closing door or window; and finally, the child enduring a violent event during which the
child is struck by an intruder, bitten by an animal bite or suffers from a natural incident that injures the child.

In classroom settings of children between 3–5 years of age, the most common elements that pose a mechanical threat include doors, tables, windows, bookshelves, chairs, staircases (falling from) and even books falling from tables (Chabbott, 2004). Mechanical threats in classrooms pose serious concerns for 3- to 5-year-olds, as children in this age bracket are curious and adventurous and, as they explore their environment or surroundings, chances of being injured increase significantly. As further outlined by Chabbott (2004), among the array of mechanical injuries in the classroom, falls are the most common due to the adventurous nature of children in this age bracket.

2.4.2 Electrical Threats

Electrical threats are normally a result of electrical fires or contact with electrical current flowing through a wire, whether exposed or not, usually in the case of a child’s inquisitiveness (Colome et al, 2004). Electrical threats come mainly in two forms: (a) electrical burns, which occur when an electric current is transmitted through body tissue with the end result being tissue damage, or electrical burns suffered as a result of fire, and (b) electric shock, which refers to the conduction of electric current by the human body resulting in the interruption of fundamental functions of the body, for example, heart fibrillation among others.

Abdazi (2007) argued that the injuries caused by electrical threats in the classroom or anywhere else mainly hinge on the amperage of the current and the amount of time the victim is in contact with the electric current, with the results ranging from mild distress to instant death. The threats posed by electrical elements and equipment are mainly as a result of poor
installation or improper use. In the case of a classroom housing 3- to 5-year- olds, an electrical threat can be posed by uncovered wall sockets and naked live wires, among others. This threat is not as common in young children’s classrooms today, as most of the sockets are properly covered, and with proper following of electrical installation guidelines, electrical threats to 3- to 5-year- old have been minimized.

2.4.3 Chemical Threats

According to Abercrombie (1990), chemical threats posed by buildings are hard to discern as they often are not visible to the naked eye and not noticed until they occur and cause harm. Chabbott (2004) pointed out that chemical injuries caused by buildings can be defined as exposure to an injurious environment or material leading to the following results: (a) surface irritation, which means that external tissues, such as the eyes or skin, get inflamed; (b) internal irritation, meaning when internal organs get inflamed, such as the irritation of the nasal passage or a sore throat, among others; (c) allergic reaction, which involves an extremely personalized blend of symptoms in response to a given state and which may range from placid and temporary to immediate and/or life threatening, for example reactions to dust such as those in HVAC ducts; (d) corrosive effects, which result in tissue destruction, for example, as a result of strong acid coming into contact with the skin; and (e) chemical reaction, which can result in fleeting or lasting damage to major body organs such as the kidneys or the heart.

According to Chabbott (2004), asbestos is viewed as one of the major chemical threats facing schoolchildren in addition to contaminated paint, among others. Asbestos has been blamed for headaches, eye and skin irritations and absenteeism among young school-going children around the globe. This has resulted in the scrapping of asbestos used in
classrooms to minimize the chances of chemical threats in classrooms; the use of safer paints has also been adopted to reduce chemical threats to children. On the other hand, chemical threats in classrooms also can emanate from ingestion of common classroom substances such as crayons, chalk or paint that children normally use to express themselves at this age, which implies that teachers need to be attentive to ensure no ingestion occurs.

2.4.4 Organic Threats

According to Carpman, Grant and Simmons (2005), organic injuries can be described as those emanating from contact with harmful organisms. The majority of most building-connected organic threats are grouped into one of two categories: contagious diseases and infections instigated by buildings. Contagious diseases result mainly from contamination by infectious organisms, for example when infection occurs as a result of one being exposed to sick colleagues due to limited space and lack of proper ventilation, resulting in increased cases of infections such as influenza and the common cold. Infections instigated by buildings are mainly a result of bacterial infection as well as microorganisms that have come about as a result of the building’s condition. For example, unsanitary conditions in classrooms can result in diarrhea or other diseases and stagnant pools of water in a washroom can host mosquitoes, leading to malaria and other infections.

According to Chabbott (2004), infectious diseases are the major organic threats to building occupants across the board. As in the case with chemical threats, the threat increases with the length of exposure and dose. Schools, offices and other places where many individuals meet regularly are the highest-risk areas for diseases caused by organic threats to spread. Less ventilated buildings, as well as spaces that are overcrowded due to inadequate space or poorly designed rooms or buildings, are susceptible to harboring organically based
diseases. Buildings that are difficult to maintain, as well as environments that are challenging
to clean, provide a rich setting for contagion to take place, and when these issues are
combined in a building or a classroom, it may lead to an epidemic.

Young children between the ages of 3 and 5 years are more susceptible to organic
threats emanating from the building conditions due to their fragile immune system as well as
due to their exploratory nature. This need to explore makes it more likely they would get into
contact with sources of organic threats such as molds on walls due to poor drainage or a poor
water connection or colds or influenza due to poorly ventilated classrooms as well as
overcrowded classes, making it easier for the spread of diseases.

2.4.5 Physiological Threats

As argued by Dickinson, Marsden and Read (2007), physiological threats usually
emanate from the demanding or overtaxing of human physical systems beyond their usual
limit, with the results being short- and long-term damage of bodily functions. These injuries
may not be expressed visually; their impacts and effects on victims are hardly ever externally
noticeable. Physiological threats or injuries are usually categorized as either long or short
term and result from, among others, muscular/skeleton stress coming from strained bones and
muscles as well as connective tissues beyond their limits. For example, a threat can emanate
from the need to open a door or window, using excessive force or suffering back strain as a
result of poorly constructed or mis-sized seats.

The second classification of physiological stress can be termed cardio-pulmonary
stress, which involves unusual strain on both the circulatory and respiratory systems, for
example when the aged can access their rooms only using stairs. The third classification is
sensory stress, whereby contagious disease infection, for example cold, influenza, measles,
etc., emanates from contact with infected individuals sharing the same small space.

Orthopedic stress and muscular/skeleton stress is viewed as the most prevalent physical threats. The need to avoid these threats is usually the main reason behind adjustable seating arrangements and diverse working surfaces, among other ergonomic features. Avoiding this threat calls for a balance of the body where the skeletal system is best suited for symmetrical activity, for example, by way of activity that makes it possible for the body to remain upright and reasonably well balanced.

In most cases, all types of building features can result in individuals performing tasks out of balance, such as closing or opening windows found behind tables or desks; recovery of hefty objects from high or low storage spaces; and sitting in poorly designed seats, straining the back (Chabbott, 2004). To this end, physiological threats in 3- to 5-year-old children’s classrooms usually emanate from poorly designed seats from where children may be forced to strain in order to reach items, such as books, or poorly designed seats that do not balance the body as required. In addition, children may develop strains while reaching or placing books or other items on shelves, tables and desks. These conditions occur mainly as a result of a designer’s thoughtlessness to the problem and can be remedied by ensuring that every actions allows for the body to be balanced at all times.

2.4.6 Thermal/Radiation Threats

Thermal or radiation threats mainly result of burns that cause tissue damage to the victim and can come from a wide range of environmental threats, such as fire, hot objects and liquids, hot atmosphere and other sources that produce heat (Chabbott, 2004). In buildings, thermal/radiation threats usually emanate from fire outbreaks or contact with hot surfaces, such as steam ducts, in industrial buildings. Fireplaces, stoves and room heaters, among other
electrical appliances that produce heat, should be installed properly to reduce thermal/radiation threats in buildings.

As fires cannot be 100% prevented in buildings, Chabbott (2004) argued that designers should therefore concentrate on fire control in addition to prevention methods. Injuries from fires in most buildings occur mainly as a result of inadequate fire detection systems. With this in mind, designers should ensure that buildings are fitted with properly working fire detection systems as this forms an important starting point in the bid to protect children as well as all other members of society. Looking at thermal/radiation threats facing children aged 3–5 years old in classrooms, the main source of these threats may result from fires caused by electrical faults or contact with a hot surface or liquids. Thus, it is important that children are not exposed to hot surfaces or liquids in the classroom and that efficient fire detection alarms should be in place at all times.

2.4.7 Emotional Threats

Emotional threats or injuries are those that result from contact with a variety of stressors from adverse conditions that demand excessive adjustment by the individuals concerned, leading to either short- or long-term emotional or behavioral anomalies (Bernard, 1999). Emotional threats are quite difficult to generalize, as to a large extent, they are intangible and result from diverse and complex sources within the victims who are largely unable to comprehend their perceptual, attitudinal and/or behavioral outcomes. The intensity and severity of emotional threats is unknown. Attig and Hopkins (2006) argued that the duration of the impacts or effects of these threats also are quite unknown. This poses a dilemma for designers on how to deal with emotional threats posed by the buildings and rooms they design.
A good portion of design-related emotional injuries can be classified into two wide-ranging categories: (a) interpersonal stressors, that is contact with individuals or groups of people that produce fear, for example fear of violent physical assault, among others; and (b) emotional stressors emanating from contact with tangible and intangible elements within the environment that result in anxiety issues, for example, the incapacity to find one’s way through a complex building or fear of fire and height, among others (Attig & Hopkins, 2006).

Emotional threats facing children 3–5 years of age in classrooms can be viewed from two angles: those children who get nervous as a result of their surroundings, such as small spaces or dizzying heights, and emotional threats caused by contact with other children who may be bullying or posing a threat of physical harm.

Emotional threats caused by building design may be the result of long flights of stairs or classrooms located on top floors when children are afraid of heights, among other causes. Bernard (1999) pointed out that crowding is one of the leading causes of emotional threat or injury and can be linked to building design, with children or individuals suffering from claustrophobia being the most severely affected. As such, building designers should consider, among other steps, the effect their designs have on the emotional soundness of users such as children and ought to ensure that flights of stairs and the location of essential rooms, such as classrooms for young children, are within easy reach.

### 2.5 Safety Theories

According to Altman (1996), safety in buildings relates to people and technology in that people are involved as they suffer injuries while making technology work and technology is a main source of threats or risks originating from the building design, a
machine or the entire process itself. Various theories that incorporate both people and technology, such as the chain theory and the domino theory, have been developed.

2.5.1 Chain Theory

The chain theory, depicted in Figure 2.1, takes the view that each step involved with dealing with losses (risks) depicts a connection in a chain. When a link is broken, the chance that a loss will occur increases; on the other hand, when the link remains unbroken the chance that a loss or threat will occur decreases significantly. As indicated in Figure 2.1, the first link is the source of loss; it is critical that one deals with the source of loss before it happens. Whether the threat is chemical, electrical, organic or any other type, one should ensure preventative measures are in place by, for example, ensuring that a building is fully fireproof before occupancy. The second link entails the reduction of hazards, which can be termed as situations that increase the chances that a threat will occur. It is important that these hazards are reduced as, for example, regularly maintaining building wiring to ensure that chance of electrical threats are minimized.

![Figure 2.1 Chain theory model; the chance of risk occurring increases when links break](Source: Taylor & Preston, 2006)
The third link relates to the minimization of loss and generally involves attempts to reduce the severity of a threat after it occurs. For example, fire extinguishers and sprinklers neutralize fire caused by thermal/radiation threats in buildings. The last link is salvage, at which point the occurrence of the event and the impact of the event has dissipated, and salvage operations can commence, including determining what caused the event and coming up with strategies to minimize any recurrence of the event.

2.5.2 Domino Theory

According to Altman (1996), the domino theory pioneered by H. W. Heinrich emphasizes the human aspect, unlike the chain theory, which focuses on technology. The domino theory, depicted in Figure 2.2, opines that 88% of accidents emanate from acts committed by individuals and 12% are because of technological factors. Heinrich, in coming up with this theory, argued that there exist an array of reasons why accidents occur. These reasons could be likened to dominos placed in a line where if one is knocked down the others follow suit. He argued that there are four dominos that result in accidents, namely social environment, personal fault, unsafe act and the injury itself.

![Figure 2.2 Domino theory model](Source: Altman, 1996)
The first domino represents the social environment which, as argued by Altman (1996), is a representation of the fact that individuals develop in different environments with some having little or no concern of the safety of others. This can result in poor construction or wiring of buildings resulting in increased chances that threats, such as electrical and mechanical threats, will occur frequently. The second domino, a person at fault, represents a situation in which an individual has particular tendencies to get involved in unsafe situations. The physiological makeup of the individual may make him/her get involved with unsafe actions due to factors such as the lack of adequate training leading to lack of knowledge that an unsafe act is being carried out. The third domino, the unsafe act itself, results in injury, such as a loss of balance in a seat or on a staircase, which results finally in the injury itself. When all of the dominos are removed, the chance of the threat or loss occurring is reduced significantly.

2.5.3 Gestalt Theory of Interior Design

One of the oldest design theories that has continued to guide designers in various fields is the Gestalt theory, which has its origin in Germany and Australia near the end of the 19th century (Lettvin, Maturana, Pitts, & McCulloch, 1961).

2.5.3.1 Meaning and Key Tenets

When used in psychology, according to Sternberg (2003), the Gestalt theory refers to the holistic functioning of the brain with regard to its perception functions. The theory suggests that the human brain perceives objects in their entirety before individuals are able to view the particular components that make up the object. Thus, according to this theory, the whole is superior to the parts that make up the whole (Sternberg, 2003). In design (interior design), the perfect classroom plan will incorporate a keen focus of the whole classroom
before breaking it down into its parts (i.e., roof, wall, desks, windows, etc.) Thus, Sheffler (2009) stated that, if the design of the whole classroom attracts the eyes, the possibility that individual parts of the classroom will be distractive is very low.

One of the principles of this theory, in the opinion of Humphrey (1924), is that peoples’ perception is a product of the interaction of the human eye with several aspects of a polluted environment. Stevenson (2013) built on Humphrey’s school of thought, asserting that the eye functions in a form of biased perception depending on what matters most at a given time. For example, this bias means that a hungry man might discover the presence of a restaurant in a place he has been for long time, not discovering it earlier because he was not interested in food earlier. This also explains why pupils in a classroom may not detect a fault in the thermal design of a classroom because they have been in the classroom only in winter (Patton et al., 2001). When the sun goes overhead and they begin to feel the dangerous radiations from a roof flaw, they notice the difference.

From this perspective, it is worthwhile to note that interior design is very similar to perception, which Burgstahler (2008) has claimed needs to be conducted as a whole rather than focusing on the parts. The aim of Gestalt psychology is to understand how the organization of cognitive and visual process occur (Hasell, 1996; Reyna, 2012; Soegaard, 2012). According to Bruce, Green and Georgeson (1996) however, it shows that senses respond differently to visual figures as a whole rather than as a simple collection of lines and curves.

2.5.3.2 Grouping principles of Gestalt design theory

The laws of Gestalt theory emerge from the fact that perception occurs from the study of the whole rather than the sum of the parts. Thus, perception of a design, especially from
the point of view of 3- to 5-year-old children, can occur well through grouping of various stimuli of color, lines, texture, shapes and many other elements (Samuels, 2007). The entirety of a design is structured using some parameters, herein referred to as laws/principles. According to Soegaard (2012), the principles, as discussed below, are: the proximity law, the similarity principle of design, the principle of closure, the symmetry principle, and other principles.

*The proximity law:* This law states that when individuals are tasked to perceive objects that are sorted unevenly, they analyze and group (perceive) those items that more closely resemble each other. Although the proximity law is applied mainly for logos used in advertising to emphasize various features of an event with which they are associated (Bruce et al., 1996), it clearly can be applied in interior classroom design. For example, a designer could decorate walls with the proximity notion in mind especially to aid the students’ learning capabilities. Rather than scatter related articles or pictures on the walls of a classroom or on charts displayed in classroom for learning purposes, designers could avoid confusing the learning ability of the pupils by having related subjects, pictures, drawings etc. close to each other. Additionally, rather than have classrooms painted with distracting multiple colors, this law calls for having the fewest as possible wall colors in a classroom.

*The similarity principle of design:* According to this principle, the reason why different elements in an assortment are placed together is that they have a number of similar features, such as shape, or share more similar features, such as color, shading etc. For example, when many circles are placed the same distance apart from each other, the law of proximity many not apply in distinguishing them. However, if some are painted black, they will catch and hold the eye of the viewer. In the interior design of a classroom for 3- to 5-
year-old pupils, this law can be applied to avoid unnecessary emotional and physiological threats. The emotional threats occur mainly when the pupils are confused by overlapping issues that they need to assess through perception for academic reasons, especially when dealing with numbers, objects and drawings. Pupils can be given an easy learning environment (thereby avoiding unnecessary physiological threats) by using simple designs in their classrooms for different learning elements such separating letters or numbers and different colors or shapes.

*The principle of closure:* This principle states that when individuals are exposed to shapes, pictures or numbers that are incomplete, they perceptually engage themselves in completing them. For example, in a series of the first four letters of the alphabet, an individual will naturally think that the next letter will be “E,” the fifth letter of the alphabet. Additionally, when there are specific parts of a picture that are missing, the mind automatically fills them in, depending on the context. According to research, the mind automatically completes an image or object in order to enhance the regularity of the environment. In design, deficits in interior classroom design will be easily noticed by pupils and the closure part comes into play when they try to respond to extreme stimuli in order to increase regularity, e.g., by taking off their pullovers, straining their eyes to see, among others.

*The symmetry principle:* In reality, objects exist as symmetrical or asymmetrical depending on their design. The principle stipulates that the mind has the capability only to perceive stimuli that are symmetrical and those that form around a center point. From a design point of view, it is always pleasing to the eye when a piece of art can be evenly divided into an equal number of parts. Designers should consider the symmetry and
proportionality of their pieces of art. In classrooms when everything that is visible is asymmetrical, it particularly distorts the learning capabilities of pupils (Samuels, 2007). Pupils can easily find themselves unable to perceive or learn easily in an environment where proportionality has numerous deficits. There are also other such mechanical and emotional threats that pupils may endure. For example, asymmetrical sealing may leave pupils with stress thinking that it may fall on them. Asymmetrical floors also pose the risk of children falling or slipping as they walk or move about.

Other principles: Other laws and principles support this design theory. For example, the law of common fate states that all objects move along the smoothest line that forms a path; thus, objects generally have a trend of motion as an indicator of the path that they move along. Therefore, if there are two forms of dots, some moving upward and others downward, through perception the two are assumed to be two distinct entities. Another principle is the continuity law, according to which, different object elements are perceptually grouped together when they form their patterns aligned within one object. The presence of an intersection line between two such object elements would suggest that they are two distinct objects. A third principle is the law of good Gestalt. According to this principle, objects tend to be grouped together when they are simple, orderly and regular. Thus, in their perception of the world, individuals tend to eliminate things that are unfamiliar to them. In classroom interior design, a deviation from the norm could allow the pupils to disregard such elements (Brown et al., 1993). For example, the seating arrangement design or even the chairs themselves could be a cause of distraction and threat at the same time.
2.6 Effect of Classroom Threats on Children’s Learning

As presented above, the classroom is faced with numerous threats ranging from mechanical, electrical, chemical, organic, physiological, thermal/radiation to emotional threats. As argued by Keith (2011), any threat that a child is able to perceive through observance or being warned about can be detrimental to the development of the child’s cognitive ability both in the short and long term. Any threat, be it chemical, organic, electrical or other, negatively affects children’s development, as these threats usually result in the development of fear about being around a certain area or room, in this case the classroom. There are various identifiable effects that the various threats discussed above can have on children learning.

Threats can lower the concentration or attentiveness of these children, as their minds focus on issues that they should not be concerned with to that extent. Children 3–5 years old require the protection of their teachers because they are incapable of determining the source of threats facing them. When children are instructed to not approach a certain area or not to use a given desk or table, their minds may be transfixed toward these areas or items as they seek to understand why they have been instructed to avoid them (Carpman et al., 2005). Children at this stage are inquisitive as well as adventurous, which means that they may be drawn to these threats once they are made aware of their existence.

This diversion of attention has the effect of negatively affecting the children’s cognitive development, especially on important aspects of their learning such as pronunciation, spelling and general arithmetic. In addition, young children’s education is negatively impacted as a result of increased absenteeism due to illness as a result exposure to chemical and organic threats (Chabbott, 2004). Absenteeism results in children missing
classes, which are important to their development, and they may be left behind academically as they try to catch up when they come back to school. Exposure to emotional and physiological threats negatively affect the development of brain, especially in those areas that are involved with emotions and learning.

Carpman et al. (2005) commented that increased research has pointed toward understanding the effect that fear has on the learning capabilities of children at a young age. Adding to this issue, Evans and Lovell (1979) argued that, when children are warned against getting into contact with elements that cause these threats in buildings, they develop fear through two structures in the brain, the amygdala and hippocampus, with the possibility that these fears may become severe enough that they impact children’s learning and cognitive capacity.

As further outlined by Evans and Lovell (1979), continued exposure to these threats breeds fear into the minds of young children, and excessive exposure to fear and states of nervousness may result in stress that can adversely impact early learning and negatively impact future performance in school, at the workplace and in society. As is evident, these threats result mainly in fear in small children, in the process limiting their capacity to learn as fear inhibits their concentration on what is being taught. Emotional fear, such as that caused by the inability of small children to navigate through buildings, may result in the child developing a negative perception about school and, in the process, negatively affecting the child’s learning.

Physiological threats, as posited by Abdazi (2007), are detrimental to the performance of children, as they negatively affect the environment in schools and, in the process, the quality of life in the classrooms. Physiological threats pose diverse problems in the learning
environment, and these threats usually have an impact on classroom management that, in turn, affects the behavior, learning, and/or cognitive development of the children. Physiological threats influence the behavior of children during classes, and paying attention and comprehending what is being instructed can become a major problem, which has been observed to cause anxiety among teachers. In addition, physiological threats affect the physical well-being of the child, leading to increased cases of absenteeism and poor cognitive development.

Organic threats can promote ailments among children, especially communicable diseases, just because of poor classroom design. Children made to share many facilities by being squeezed into rooms that are poorly ventilated leads to the growth of biological pathogens that can spread from one child to another, perhaps because of the lack of hand-washing facilities in the classroom environment.

\section*{2.7 Safety Measures in Classrooms}

As evident from this discussion, the threats facing children in the classroom result mainly from human neglect or oversight. As such, each threat can be addressed at the interior design stage of classroom construction to ensure that the threats are identified and minimized from the outset. For example, electrical threats can result from shoddy wiring or sockets either exposed to water or within the reach of small children. Thus, it should be determined that the electrical wiring has followed the set guidelines in building codes and that sockets are placed out of the reach of children, or if this is not possible, that the sockets are completely covered when they are not in use.

Chemical threats can emanate from poisonous building materials such as asbestos and lead paint, among others. To curtail these threats of chemical threats, safer building materials
for classroom buildings, such as water-based paint and less hazardous roofing materials, such as iron sheets, among others, should be used. In addition, at all times teacher supervision should be promoted to minimize cases in which children ingest materials that contain harmful chemicals or materials used should be more eco-friendly and made from natural materials.

Mechanical threats emanate from the classroom design; windows and doors should be easier to open and located in an area that is freely accessible to both the teachers and the children. In addition, classrooms for small children should be housed on the ground floor to avoid mechanical threats posed by staircases or elevators. Furthermore, door and window edges should be covered to lower the impact of any contact with them by the children, and bookshelves should be affixed to the walls to ensure that they cannot fall on the children.

Emotional threats facing children 3- to 5-years old in classrooms can be viewed from two angles: namely, those children who get nervous as a result of their surroundings, such as being in small spaces or at dizzying heights, and emotional threats caused by contact with other children who may be posing physical harm threat or bullying them. As such, there should be ample space to move for young children who are adventurous and like to explore and, as mentioned above, classrooms for small children should be housed on the ground floor. In addition, small children should be protected from bullying or any other mistreatment within and outside the classrooms.

Looking at thermal/radiation threats facing children 3- to 5-years old in classrooms, the main source of these threats may be from fires caused by electrical faults or contact with a hot surface or liquid. It is important that children not be exposed to hot surfaces or liquids in the classroom, and efficient fire detection alarms should be in place at all times. In fact, at
this age, children should not be exposed to any hot element, whether it is gaseous, liquid or solid, in the classroom.

Physiological threats in a classroom for 3- to 5-year old children usually emanate from poorly designed sitting spaces, where the children may be forced to strain in order to reach elements such as books, or poorly designed seats that do not balance the body as required. Thus, desks, tables, and bookshelves should be designed and placed in a way that they are easily accessed by the children to ensure that they do not strain their bodies as they sit or as they try to reach for something.

2.8 Policy Measures That Will Ensure Safety in Children’s Classrooms

According to Piotrowski and Rogers (2010), various policies can be adopted to ensure the safety of children while in the classroom. These may include teachers clearly communicating and enforcing classroom rules, such as keeping away from electrical sockets, to the children to promote their security. Classroom rules should be uniform across various institutions to ensure that they can be easily amended through the sharing of experiences and ideas in the process, ensuring that the young children are safe. A second policy measure should be to focus on room arrangement, including the amount of furniture being kept at an essential minimum to lower cases in which children bump into furniture, especially sharp edges, considered as the most dangerous to small children in classrooms. The room arrangement should also be simple enough to allow for ease of movement for both the children and teachers.

In addition, classrooms for small children should be housed within accessible areas where children do not need to use stairs or elevators. This minimizes the chances of the children being hurt while trying to reach their classroom. Furthermore, some young children
may be afraid of heights. Thus, classrooms housing children 3–5 years old should be required to be on the ground floor and, if not in their own building, far from the classrooms of senior students.

2.9 Qualities of a Well-Designed Classroom

According to Sheffler (2009), there are standards that are required for the design of classrooms for children 3–5 years of age in order for those classrooms to be authentic and conducive to pupils as well as their teachers and other people visiting the premises. The following qualities can be found in classrooms that are well designed interiorly for pupils of this age. These standards involve space and spacing, movement within the classroom, ease of supervision, window design, lighting, room size, flooring, ventilation, sink design, color choice, storage and other elements of classroom design.

2.9.1 Space and Spacing

Although space and spacing may not be part of the interior design elements of a classroom, it affects the final layout and other facilities included in the interior design. The term “space” is used to mean the actual room or area that pupils use as a learning or playing venue. The pupils may use the space to sit waiting for teachers to give instructions or to read books, discuss with others, talk about topics that interest them, eat or do any other activity at the learning facility. Generally, the space should be large enough to accommodate all the pupils without any straining on their part so that learning can be smooth (Miller-Cochran & Gierdowski, 2013). In rooms that are too small, pupils are likely to suffer high temperatures, fight with each other and contract an infection of communicable diseases such as the cold or flu, or even more serious diseases, among others. This type of space also limits the movement of the teacher and the pupils themselves.
Without movement, it can be very difficult for a child under the age of five to develop well emotionally and physically. By the age of three all children, unless they have a disability, are capable of moving. They want to climb on objects and use other objects to move, for example. It is normal to find these children trying to climb on chairs, desks or even tables because of the urge to move (Patton et al., 2001; Samuels, 2007). When space is a limiting factor, children are likely to suffer many threats, such as physical injuries. Being exposed to a threat means the pupils may be prevented from growing and developing optimally because they learn that these activities involving movement are bad after occasionally being refuted by their teachers. Having enough space for movement in a classroom helps pupils discover their potentials and learning what they are capable of doing, resulting in good physical and emotional growth. Otherwise, the children might be deprived off their need to develop a good self-concept and personal identity.

Pupils, especially those who are young, should be occasionally taken away from the crowd to a private space to ease stress on them. This helps them to take a rest in addition to being able to quietly observe the environment and emotionally recharge. This withdrawal also can help young children develop friendships in small groups if, for example, two toddlers are similar in developmental growth features. A number of things can be done to provide pupils with private space, for example making sure there is a tunnel or a cabinet whose doors have been removed and that is well carpeted and building classes with a comfortable ceiling height, among others.

To create different classroom environments, it would be wise to follow some design standards. For instance, walls can be constructed as low as 24 inches tall or as high as 30 inches with a 5-inch-high carpeted platform area. Unlike with high-wall construction, lower
partitions help the pupils have a feeling of discrete space and, yet, also a connection to the outside world. Lower walls also are good because, as children take part in small group play activities, the childcare personnel are able to well supervise all the children simultaneously and appropriately, unlike when the partitions were higher than 30 inches.

There are many activities, such as reading books and building with blocks, that can work well among pupils only if the pupils are contained in defined spaces. In light of this, a child playing with blocks on a platform that is raised is naturally confined to that activity area and may not be able to let his/her playing blocks spill over to adjacent activity areas, which could lead to classroom accidents.

2.9.2 Movement within the Classroom

Generally, children need to continue with their natural developmental growth such as running over, jumping or climbing on objects; crawling on the floor; and many other activities. The interior design of the classroom should not in any way prevent the performance of these activities but, instead, should be adapted to support them. Slightly older children, such as 7-year-olds, are happy when their teacher instructs them to go out and run for 20 minutes or so. These pupils can also play with paint, read books and build things with blocks or sticks, among others. However, a 3-year-old child may not adjust to such limitations and may just want to climb on objects, crawl, grasp objects and make few but continuous movements. The environment must always support this child’s fundamental right.

To achieve the movement needs outlined above, Gettinger, Elliott and Kratochwill (1992) suggested that the appropriate equipment required to meet the needs of children, infants and toddlers subjected to group care should be installed in a classroom. Some equipment may seem appropriate, but in the end cause conflicts among the pupils in their
small groups. For instance a slide can be used by only one pupil at a time and could cause a serious group conflict if utilized under poor supervision. A slide that is wide enough to support two or more children simultaneously is better and certainly helps develop positive interaction, exploration and understanding.

2.9.3 Ease of Supervision

Ease of supervision means that teachers and childcare personnel are able to oversee the activities in which the children are engaged without much strain and stress. That is, if the space is well designed, a teacher can be anywhere in the classroom and still supervise all the pupils. To accomplish this, classrooms should be constructed with activity areas placed along walls, the center of the room left open and separate diapering units and food galley separated from main activity areas by half walls. Nap rooms, where available, need to be separated by walls that are approximately 30–34 inches high so that the teacher can easily see what happens there.

2.9.4 Window Design

Windows allow children to feel that they are connected to the natural environment. A classroom that lacks natural light is an indication of poor interior design. As much as possible, light should be let in through windows and the doors. The recommended placement of windows is at a height of about 26 inches, which is low enough to let in natural light and air to the classroom. According to the Program for Infant/Toddler Care and Community Playthings ([PITC/CP], 2008), 26 inches is an ideal height for windows because many children’s play equipment are about 24” high and won’t block the light; besides, such a height allows pupils see outside and still allow creative activity areas on the walls. The only
means for getting fresh air into the classroom is also through the window opening, which must always be used with safety locks to limit other threats that may occur.

2.9.5 Lighting

There are a number of negative consequences of poor lighting including eye strain. When lighting is too bright, children risk losing their visual acuity, whereas light that is too dim hinders visibility, which can result in, among other things, poor academic performance. What kind lights to use should be considered by interior designers before installation. For example, some fluorescent lights can make a classroom look institutional, like a hospital, and may not be conducive for learning. Recommended classroom lights in elementary schools are incandescent-type lights that have many similarities with the natural sunlight. As cited by Blaut (1987), using incandescent-type lights softens a classroom environment, making it seem more like a home. Moreover, different lighting, for example pendant or track lights, can be used for different activities, and wall sconces or recessed lights can be used to effectively for indirect lighting needs. Classroom lights should be designed with dimmers that allow for adjustment of the light at different times of the day or for different activities.

The feeling of space and function also depends on the kind of light bulbs used. For instance, the use of long fluorescent tubes makes classrooms feel cold or institutional. According to Clark (2010), good lighting not only gives meaning to space and other functions in a classroom but use of a combination of track, pendant and recessed lightings also provide overall good lighting.

2.9.6 Size of Room

As already mentioned, children need enough space for them to be able to move, run, crawl, climb and play with objects. This is especially important in group childcare settings,
where each individual or pair of pupils should be assigned some private space. The classroom should not be like a grand hall, nor should it be too small of a space. An overly full classroom can make pupils be too aggressive to foster good relations, and such a room increases the chance for illnesses to be spread among the children. According to Dudek (2008), children squeezed into too small of a space will lack a sense of focus and interaction, and may tend to wander aimlessly.

Some room-size standards are available for interior designers. Ching (1996) proposed a room of about 350 square feet in which children are clustered in groups of between two and six individuals. Where children number more than six, for each additional child 50 square feet should be added to the size of a classroom (Ching & Binggeli, 2007). However, room size means the entire classroom space not just space for pupils. Ching and Binggeli noted that these space requirements are not inclusive of space needed for other related activities such as cooking/serving food, diapering, napping, bathing and storage, for which other arrangements need to be made.

2.9.7 Flooring

Many classrooms depend on floor space for their functionality. Thus, floors need to be well designed. For children specifically, floors should be carpeted for general safety to minimize injuries in case of a fall, tumbling over an object or colliding with others. However, places such as entrances, bathrooms, eating and diapering areas and messy play areas, such as water play/painting areas, need not be carpeted. According to Ching and Binggeli (2007), in order to prevent the growth of microorganisms, such as bacteria, molds and fungi, neutral-colored, low-pile, anti-microbial carpeting materials should be used.
2.9.8 Ventilation

Ventilation is important if children are to be free from feeling suffocated or fatigued, or getting headaches. Leslie (2000) argued that classrooms need natural ventilation mechanisms rather than the use of fans, which pose additional dangers for pupils’ health. For instance, windows should be able to be opened easily, ceiling fans should be operational to circulate air and, as much as possible, room air should not to be recycled. Moreover, windows should be designed at a child-friendly height in order for the pupils to be engaged throughout the day as well as remain connected to the outside.

2.9.9 Sink Design

A childcare environment should be designed with many hand-washing facilities because of the kinds of activities in which the children engage. This would help protect the children from contracting diseases, especially if children are encouraged to practice hand washing before handling anything. Sinks help in managing the washing activities among children, but different sinks need to be provided for different purposes such as preparing food and diapering. Trough sinks with two to three faucets are recommended to be used as this minimizes the time children need to wait as well as encourages good social interaction and behavior amongst the pupils.

2.9.10 Choice of Color

A good design and choice of colors helps pupils have a feeling of connectedness to the home environment, as many of them could be homesick and want to be with their parents. Colors can be cool or warm, bright or dim, dark or light. A mixture of different hues and a spectrum of the colors would be stimulating and encouraging to pupils and their caretakers. However, a poor choice of colors would destabilize the learning environment and create
unusual and inappropriate moods for learning and child growth purposes. Rather than opt for bright colors, Gage (2000) noted that neutral background colors are good for learning as they depict a calm and focused environment. In addition, by using colorful pictures, toys and materials against such neutral backgrounds, children are able to remain focused, especially due to the ability to distinguish objects from their backgrounds.

2.9.11 Storage

A storage area within the classroom is also important for a developmentally and environmentally friendly design. A storage area should be easily accessible and located close to every activity area to avoid confusion and reduce the time needed to locate materials for various activities. The storage areas can also be placed along walls to avoid consuming space that would be valuable for children to engage in activities.

2.9.12 Other Elements of Classroom Design

In the “other” category, a lot of emphasis is placed on the type of paint used in classrooms. Mahnke (1996) demonstrated that a room’s atmosphere is dependent on the type of paint finish. Classroom paint finishes, according to Mahnke, need to have a neutral feel; and, for example, an eggshell or satin finish is good for the walls. He stated that when glossy paints are used, the impression created is that of institutional rather than a childcare atmosphere. In many cases, a semi-glossy finish would do well on woodwork used in a classroom.

2.10 Conceptual Framework

Based on the preceding review, an interior design threats conceptual framework model, depicted in Figure 2.3, has been formulated. Generally, interior design practice is based on industry design policies, which define the standards applied to specific settings. The
Figure 2.3 Interior design threats conceptual framework model

classical framework presented here is intended to contribute to the refinement of similar
standards for the design of facilities for children and a reduction in the incidence of threats
that affect the health, academic performance, and overall well-being of school children.

2.11 Summary

This chapter has served to point out on some aspects of interior design and safety
theories. One important element of design of classrooms for children is space. Without
movement, it can be very difficult for a child to develop well emotionally or physically, as
young children often climb on objects and use other objects to move along to try climbing on
chairs, desks or even tables because of the urge to move. Therefore, the Gestalt theory of
interior design should be considered as an important guideline for classroom experts.
CHAPTER 3. RESEARCH ON CHILDHOOD SCHOOL SAFETY

3.1 Introduction

In this chapter, results of literature search pertaining to threats faced by children 3–5 years of age in classrooms are represented. Data are also provided to identify how such threats affect children’s learning in schools and to establish whether there are any safety measures that can be taken during the interior design of the classrooms to minimize threat exposure to children.

3.2 The Interior Design Industry

There are over 2.3 million designers in the United States, reflecting about a 29% increase since the year 2005. Furthermore, earnings from this industry have improved well, by not less than $3.4 billion. Additionally, if the income earned by consultants, freelancers and in-house designers in the industry were combined, it would total about $15 billion, an indication that the industry is performing well. Although since 2005 the number of freelance and in-house interior designers has decreased slightly, in general there has been an increase in design professionals. In addition, about 16% of all businesses in design field are engaged in exhibitions or interior design, and 6% of the business enterprises are engaged purely in interior design, such as for classrooms and other interiors (Bureau of Labor Statistics, 2012).

The Design Council (2010) indicated that, out of all registered interior and exhibition designers, those who actively work in the US constitute 16%. A study conducted by Zhu and Wang (2012) disclosed that most businesses in interior design based in public schools and the private sector operate on a budget and total fee incomes of $100,000 and below. From their analysis, 42% of businesses engaged in interior design have the feeling that there has been an increase in the demand of their services since 2005.
According to the Design Council (2010), about 92% of competitors in interior design globally come from the United States and Europe with the US leading in interior design market share of an estimated 23%. Interior design is an ever-evolving profession that requires new skills (Sheffler, 2009). However, are there standard rules and procedures that guide the interior design of spaces for minors, specifically school spaces for children below five years of age? This question is motivated by the fact that several classroom threats have arisen in the last few years (Zhu & Wang, 2012), and the children affected suffer in attaining formal education. Data provided in the next sections shed light on this argument.

3.3 General Classroom Design and Description

According to the Bureau of Labor Statistics (2012), many elementary schools in the United States start their day at 7:30 a.m. and end at 3:30 p.m. with typically two breaks: a morning break and lunch break. Some schools open earlier and close very late in the day to accommodate parents’ work schedules. The timing of breaks is not uniform across all schools in United States, but most include at least two breaks (in some cases three). As shown in Table 3.1, the majority of elementary classes (56%) has break times starting at 10:00 a.m. and ending before 11:00 a.m. The first break, usually lasting between 15 and 30 minutes, starts at the earliest at 9:30 a.m. in about 23% of elementary schools in United States and ends at 11:00 a.m. in approximately 40.3% of schools (Dapi, Rocklo, Georges, Ekoe, & Tord, 2011).

Table 3.1 Distribution of Daytime Breaks in Elementary Schools in the United States

<table>
<thead>
<tr>
<th>Time of first break for pupils</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:30–9:59 a.m.</td>
<td>56</td>
<td>23</td>
</tr>
<tr>
<td>10:00–10:29 a.m.</td>
<td>136</td>
<td>56</td>
</tr>
<tr>
<td>10:30–11:00 a.m.</td>
<td>51</td>
<td>21</td>
</tr>
</tbody>
</table>
According to data obtained from the Debbie Alexander, Laurie Lewis (2014), the coefficient of variation is 30 percent in this data analysis. The percentage of public school with windows and door was 32%, with both heating system and air conditioning system was 30%. The percent of plumbing and lavatories is 31%, and electrical supply is 22%. In this research, the percent of energy management system and security system was 29%. The percentage of life safety features was 19%. The public school also paid attention for the exterior lighting design, which had 29%. The other research data obtained from the Cynthia Rice, Senior Policy Analyst, Association for Children of New Jersey (2004), the research number of preschool center is 90. About 36% preschool had toilets in each classroom, only 58% classroom pay attention for the natural light design, and about 79% preschool center had outdoor play area, which also was the emergency exit. 29% center was built in basement, 70% classroom were in first floor, 24% preschool center stayed in second floor, and only 2.2% preschool classrooms were built in third floor.

Desks were made of wood and placed in rows of six columns. Students sat three to a desk in about 92% of the classrooms. A few developed classrooms, less than 8% of 243 classrooms surveyed, had individual chairs for children (Docherty Kendrick, Sloan, & Lerpiniere, 2006). Most of classrooms had water supply in each single classroom; where classrooms had no water supply, at least the schoolyard had tap water.

### 3.4 Threats Faced by Children 3–5 Years of Age in Classrooms

#### 3.4.1 Thermal Threats

Thermal threats are defined as the risks that carry potential harm to persons exposed to poor ventilation, extreme temperatures, burns or fire-related incidents. Electric failures are
classified also as part of the thermal threats for the purposes of this study (Sheffler, 2009).

On average, about 7,000 pupils die every year in the United States because of thermal threats, and more than two million others suffer serious injuries leading to disabilities of the skin, limbs and head, among other serious disabilities (Table 3.2). As shown in Table 3.2, people who are seriously injured number much more than those who die from thermal threats. In this case, out of every 100 people suffering thermal threats of interior design, about three people die and the rest receive serious injuries (Docherty et al., 2006). Those who escape with minor injuries are not part of this tally but could be more than those suffering serious injuries. Moreover, out of the 2 million serious injuries shown in Table 3.2, more than 62% of affected people are students in academic institutions of various levels (see Table 3.3).

**Table 3.2 Deaths and Injuries by Thermal Threats (Annually)**

<table>
<thead>
<tr>
<th>Result of thermal threat exposure</th>
<th>Frequency (n)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deaths</td>
<td>7,000</td>
<td>0.35</td>
</tr>
<tr>
<td>Serious injuries</td>
<td>2,000,000</td>
<td>99.65</td>
</tr>
<tr>
<td>Total</td>
<td>2,007,000</td>
<td>100.00</td>
</tr>
</tbody>
</table>


**Table 3.3 Serious Injuries, Student vs. Nonstudent (Annually)**

<table>
<thead>
<tr>
<th>Serious injuries (by affected category)</th>
<th>Frequency (millions)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students</td>
<td>1.24</td>
<td>62</td>
</tr>
<tr>
<td>Others</td>
<td>0.76</td>
<td>38</td>
</tr>
<tr>
<td>Total</td>
<td>2.00</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Docherty et al., 2006.
Docherty et al. (2006) reported that only about 12% of the 62% of students affected by thermal threats (approximately 0.12 million) were students in institutions of higher learning such as universities and colleges. The remainder of those affected was younger: 28.9% were high school students and 49.1%, were pupils at the elementary school level (primary school and kindergarten; see Table 3.4). Clearly the impact of thermal threats among students is affected by age; many children in elementary schools suffer serious injuries from thermal threats and university students suffer the fewest thermal injuries because of the ability to control themselves and the environment around them.

**Table 3.4 Serious Thermal Injuries Among Students (Annually)**

<table>
<thead>
<tr>
<th>Student category</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students at universities and colleges</td>
<td>148,800</td>
<td>12.0</td>
</tr>
<tr>
<td>High school students</td>
<td>358,360</td>
<td>28.9</td>
</tr>
<tr>
<td>Elementary school pupils</td>
<td>608,840</td>
<td>49.1</td>
</tr>
<tr>
<td>Totals</td>
<td>1,240,000</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: Docherty et al., 2006.

Elementary school pupils are usually 1–14 years old on average, but this age varies with country and continent. In the United States, many elementary school pupils are 0–12 years of age, whereas in Africa and other developing parts of the world, the age extends to about 17 years. According to research by Snyder and Dillow, (2012), pupils in primary schools are classified as those in preparatory classes (baby class, nursery, preschool and kindergarten), who are normally 5 years of age or younger; lower primary pupils, who are up to about 9 years of age; and upper primary students, who are up to about 12 years of age for normal pupils. Snyder and Dillow added that preparatory classes usually have many students, and that the average elementary school grade composition is as follows: preparatory, 35%,
lower primary, 46%; and upper primary, 19%. Using these figures, if children 3–5 years of age represent 35% of elementary school pupils, their prevalence of thermal injuries would be 35% of 49.1% (the percentage of elementary school pupils among all students who suffer from serious thermal injuries annually). However, in elementary schools, the children most affected by thermal threats are those in the middle years (lower primary), as shown in Table 3.5, because they do not get as much attention from caregivers as those in preparatory classes nor are they able to take care of themselves as are pupils in upper primary classes. Thus, children 3–5 years old who suffer serious thermal threat injuries average about 0.21 million annually (Table 3.5). On the same note, of the 7,000 annual deaths due to thermal threats, about 612 children 3–5 years of age die (National Society for the Prevention of Cruelty to Children. (2013).

<table>
<thead>
<tr>
<th>Table 3.5 Serious Thermal Injuries in Primary Schools (Annually)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Student level</strong></td>
</tr>
<tr>
<td>Upper primary</td>
</tr>
<tr>
<td>Lower Primary</td>
</tr>
<tr>
<td>Preparatory</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
</tr>
</tbody>
</table>

Source: Docherty et al., 2006.

In addition to the thermal threats discussed above, there are other environmental factors that can cause burns or expose people to thermal threat. These factors include: contact with hot objects or materials, for example when children touch hot elements during class practicums or metal objects that have been exposed to the sun for too long. Other factors, according to William et al (2001), include accidental fires, such as flames from lamps, hot gases or smoke; contact with hot liquids such as hot water, either directly or as a result of a
fall of a broken container; and hot environments and reflected heat (e.g. from a concave lens or mirror).

**3.4.2 Biological/Organic Threat Prevalence Among Children**

Poor classroom design in some parts of the world has been observed to allow for the proliferation of biological microorganisms such as anthrax (*Bacillus anthracis*), botulism toxin (*Clostridium botulinum*), and small pox germs (*Viarola major*). Other biological threats include bubonic plague (*Yersinia pestis*), brucellosis (*Brucella suis*), Q fever (*Coxiella burnetti*), viral hemorrhagic fever agents and finally tularemia (*Francisella tularensis*) (Klatte, Hellbrück, et al., 2010). In many cases, poor flooring and wall design have allowed for the attraction of biological factors, including the growth of poisonous mushrooms, weeds and ferns on the walls or floor. Although most of these threats are not common in the US, knowledge of them helps interior design activities to be focused on hygiene and proper ventilation as preventive measures recommended later in this study. The reason is that poor ventilation and drainage also create hazards in classrooms, causing communicable diseases and diseases of the respiratory system. Children 3–5 years old generally learn by experimentation (touching, feeling, tasting and other forms of testing). Thus, this experimentation becomes much riskier when the environment in the classroom is not hygienic because of poor interior design.

The symptoms of infection by different biological microorganisms, such as viruses or bacteria, are variable as it depends on how many days the germs remain in the incubation stage before developing among the infected pupils. Although the incubation time could be as short as three hours, such as for viral and bacterial infections, symptoms could as well occur years later. For instance, bacteria that cause pneumonia stay in the incubation period for
about four weeks. The actions of these agents may lead to high levels of sickness and death in children and even other people if they are poorly controlled.

3.4.3 Radiological/Chemical Threats

There are three main types of radiological hazards relevant to this study, including alpha rays, beta rays and gamma rays. For these types of radiation to occur there must be spontaneous decay of radioactive metals, such as lead, commonly referred to as isotopes. The radiation present in isotopes occurs naturally in gaseous states and aerosols or is carried around in other materials (e.g., solid matter). Their effects can be both long term and short term. As pointed out by Klatte, Hellbrück, et al. (2010), pupils in classrooms are commonly exposed to chemical threats because of handling electronic products such as personal computers, radio receivers, phones, microwaves, cameras etc.

One survey revealed that many devices used in elementary school classrooms have a potential radiological/chemical threat. As shown in Table 3.6, 55% of children below 5 years of age in classrooms in the United States have already handled computers or at least been exposed to them in class, for daily education, 65 percent of children exposed in front of DVD and TV, and 87 percent classroom used CD player to play some videos. In addition, more than 57% of pupils have been exposed to phones and radio waves and phones at this age are and 52 % have been exposed to audiocassettes devises with potential radiological/chemical threats (percentages equal more than 100 because the same pupil could have numerous sources of exposure).
Table 3.6 Sources of Exposure to Radiological Threats by Children 3–5 Years of Age in the United States

<table>
<thead>
<tr>
<th>Source of exposure</th>
<th>Percentage of affected pupils</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal computers</td>
<td>55</td>
</tr>
<tr>
<td>DVD and TV</td>
<td>65</td>
</tr>
<tr>
<td>CD Player</td>
<td>87</td>
</tr>
<tr>
<td>Radios and phone devises</td>
<td>57</td>
</tr>
<tr>
<td>Audiocassettes</td>
<td>52</td>
</tr>
</tbody>
</table>

Source: Ellen et al (2010)

3.4.4 Pollution Threats Among Elementary School Children

According to research by the World Health Organization (WHO, 2010), many schools, cities and towns in the developed world have pollution levels far higher than the WHO standards call for. Most of the air people breathe is full of industrial exhaust that may not be good for human respiration. People living in more than 47% of American cities fall victim to bad air by ALA (2014). Specifically, WHO reported that in the last decade the number of asthma cases among school children worldwide has doubled, whereas in the United States, this number has increased by more than 60% since 1980. According to American Lung Association (2012) researched, the rate per 1000 population of under five years old children got asthma is 57.1 percent in 2001, however, this rate was increased to 68.5 percent in 2011. Approximately 200 towns and cities in Russia have pollution rates that exceed WHO standards. In these cities, it is estimated that air pollution leads to 17% of all diseases among school-going children. In developed countries, pollution is responsible for nearly 50 million chronic cases of coughing just in children under 14 years of age, with the majority of those cases in children under 5 years of age. Sometimes the pollution levels in India, China and Latin America exceed the WHO limits by a factor of more than three, increasing to a factor of about six in major Chinese cities. It has been estimated that,
globally, more than 1.5 billion people living in urban areas breathe in air with pollution that exceeds WHO standard guidelines (WHO, 2010).

Poor design of classrooms in the United States exposes children 3–5 years of age to many types of air pollution that represents a combination of biological, physical and chemical threats. Air pollution in classrooms, as expounded by Klatte, Hellbrück, et al. (2010) is caused by poor paint as a result of interior design, displays on the walls and other class decorations, markers, a room exposed to dust and air due to poor acoustics and many other causes. These are easily avoidable issues with good design planning.

3.5 How Children’s Learning in Schools is Affected

A number of studies have been conducted on the effects of interior design defects on children under the age of 5 years in elementary schools. For example, in a study in West Africa, Dapi et al. (2011) concluded that a strong relationship exists between the average daily classroom temperature and schoolchildren with symptoms such as feeling hot, headaches and fatigue. According to the research, thermal threats caused many effects in the children, but the most common are listed in Table 3.7.

Notably, many schoolchildren indicated that they were very hot (48%), had fatigue (76%) and suffered headaches (nearly 38%) because of thermal exposure, which can happen because of poor classroom design. The data shown in Table 3.7 reveals that girls are more affected by thermal threats in classrooms than are boys. For instance, the prevalence of headaches among girls versus boys occurs at a ratio 58:39, feeling “very hot overall” at a ratio of 37:21 and feeling “very hot in the head” or fatigue at a ratio of 21:18. This calls for
Table 3.7 Thermal Effects on Children

<table>
<thead>
<tr>
<th>Thermal effect</th>
<th>Overall percentage</th>
<th>Prevalence among pupils by gender</th>
<th>Female (%)</th>
<th>Male (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feel very hot</td>
<td>48</td>
<td></td>
<td>37</td>
<td>21</td>
</tr>
<tr>
<td>Fatigued</td>
<td>76</td>
<td></td>
<td>21</td>
<td>18</td>
</tr>
<tr>
<td>Headaches</td>
<td>38</td>
<td></td>
<td>58</td>
<td>39</td>
</tr>
<tr>
<td>Absent minded</td>
<td>62</td>
<td></td>
<td>52</td>
<td>48</td>
</tr>
<tr>
<td>Slower writing speed</td>
<td>45</td>
<td></td>
<td>71</td>
<td>63</td>
</tr>
</tbody>
</table>

Source: Dapi et al., 2011.

Specialized care for girls against thermal threats in classrooms especially for those 3–5 years old and sharing classrooms with boys. In addition, up to 62% of pupils at the elementary school level become absentminded and 45% developed slow writing speed due to thermal threats (Dapi et al., 2011).

Although this research was conducted in Cameroon, it depicts a general picture because children in elementary schools may generally be exposed to similar conditions. Therefore, the prevalence of these effects in other parts of the world may not be different except for in different seasons, such as in winter. However, the Design Council (2010) noted that the effects of extreme temperatures, whether too high or too low, are the same and that, generally, pupils will feel dizzy, fatigued, nervous etc. In addition, whether it’s very cold or very hot, there is also exposure to additional risks herein referred to as biological risks; the pupils may be infected by bacterial, fungal or viral infections such as those mentioned earlier (Klatte, Hellbrück, et al., 2010).

In conclusion, in order to enhance learning and teaching activities, there is the need for an improvement in school environmental conditions. High classroom temperatures, a condition that nearly every schoolchild in the present day can be exposed to at some point, have been confirmed to be a cause of fatigue, feeling hot and headaches (Dapi et al., 2011).
Additional effects on pupils in class, according to the Global Health action survey (Dapi et al., 2011), are shown in Table 3.8 (the numbers in brackets represent the percentages of affected pupils). The table values, from a survey in three different schools, also emphasize that girls are most affected by classroom interior design threats than are boys. Girls more often reported exaggerated thirst, fever, headaches, malaria, nausea, hotness in the head and sleepiness in classrooms than did boys.

Table 3.8 Effects of Classroom Threats on Children 3–5 Years of Age

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Girls/boys</th>
<th>School 1</th>
<th>School 2</th>
<th>School 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>265</td>
<td>163/122</td>
<td>89</td>
<td>85</td>
<td>111</td>
</tr>
<tr>
<td>Slept in class</td>
<td>36 (99)</td>
<td>40/32</td>
<td>39 (35)</td>
<td>43 (32)</td>
<td>29 (32)</td>
</tr>
<tr>
<td>Sick</td>
<td>15 (40)</td>
<td>17/12</td>
<td>10 (9)</td>
<td>21 (15)</td>
<td>14 (15)</td>
</tr>
<tr>
<td>Thirsty</td>
<td>62 (166)</td>
<td>63/60</td>
<td>47 (42)</td>
<td>64 (45)</td>
<td>71 (73)</td>
</tr>
<tr>
<td>Fatigue</td>
<td>75 (202)</td>
<td>77/71</td>
<td>73 (55)</td>
<td>80 (58)</td>
<td>73 (73)</td>
</tr>
<tr>
<td>Vertigo</td>
<td>18 (48)</td>
<td>20/15</td>
<td>14 (12)</td>
<td>23 (17)</td>
<td>18 (19)</td>
</tr>
<tr>
<td>Malaria</td>
<td>8 (21)</td>
<td>9/6</td>
<td>5 (4)</td>
<td>13 (9)</td>
<td>7 (8)</td>
</tr>
<tr>
<td>Fever</td>
<td>5 (14)</td>
<td>6/5</td>
<td>2 (2)</td>
<td>12 (8)</td>
<td>4 (4)</td>
</tr>
<tr>
<td>Headache*</td>
<td>49 (134)</td>
<td>58/39</td>
<td>55 (49)</td>
<td>60 (44)</td>
<td>38 (41)</td>
</tr>
<tr>
<td>Nausea</td>
<td>13 (35)</td>
<td>13/12</td>
<td>7 (6)</td>
<td>22 (16)</td>
<td>12 (13)</td>
</tr>
<tr>
<td>Very hot overall*</td>
<td>31 (78)</td>
<td>37/21</td>
<td>20 (17)</td>
<td>19 (14)</td>
<td>49 (47)</td>
</tr>
<tr>
<td>Very hot in the head*</td>
<td>20 (50)</td>
<td>21/18</td>
<td>22 (19)</td>
<td>14 (10)</td>
<td>21 (21)</td>
</tr>
</tbody>
</table>

*aPercentage (%) of girls vs boys.
*School 1, week 1: March 15–19, 2010 in Yaoundé.
*bSchool 2, week 2: March 22–26, 2010 in Yaoundé.
*cSchool 3, week 2: March 22–26, 2010 in Douala.

*Significant differences between boys and girls (P = 0.010; 0.014; 0.027, for headache, very hot overall, and very hot in the head, respectively).

Note. School 1, school 2, and school 3 are three different groups of school children.
Source: Dapi et al., 2011.

3.6 Effects of Chemical Threats

Research has shown that the rate of children vulnerable to illnesses caused by pesticides is higher among children than among adults and that most U.S. children’s learning facilities use different types of pesticides (Design Council, 2010; Docherty et al., 2006; Sheffler, 2009). One of the reasons this is a threat to children is that children have a high
affinity to play and are less sensitive to their cleanliness. Thus, they could easily touch their hands to their mouth after an encounter with dangerous pesticides in their vicinity. This increases their chances of ingesting pesticides hence becoming ill or even dying. They also have a bigger food intake and breathe in more air relative to their body weight, and this increases the chance of them unknowingly ingesting pesticides and other chemicals. Pesticide use included in the design of classrooms increase the risk of chemical threats to school children. The National Academy of Sciences reported that U.S. elementary classrooms and toilets are installed with pesticides meant to counter mostly mosquitoes and cockroaches (Patlak, 2003). Out of every 100 elementary schools in London, about 32 have pesticides used in the classroom and 41 have pesticides used in classrooms that are used for children 3–5 years old. Therefore, the risk of chemical threats remains high among these children.

Findings released by Dapi et al. (2011) disclosed that many threats to children were associated with exposure to harmful chemicals and led to symptoms such as headaches, rashes, breathing difficulties, dizziness, nausea and mental disorientation. According to the report, schools place priority on the cheapest way to eliminate pests (using pesticides) rather than prioritizing the health of pupils whose care is entrusted to them.

Research by Siddarth et al. (2014) has shown that exposure to pesticides increases the prevalence of asthma symptoms as well as immunological, neurological, respiratory and endocrine system impairments. Exposure to pesticides also can make children more prone to serious illnesses such as brain cancer, elevated cases of asthma and soft tissue sarcoma. In addition, research by Mathews et al (2011) has revealed that many pesticide-caused diseases among children go unnoticed, even though these chemicals can elevate the respiratory disorder symptoms and often reduce the concentration span of pupils. Generally, the negative
impacts of pesticides far outweigh the positive ones. It is time that school managers consider biological pest control methods and sanitary procedures to keep the pests away.

### 3.7 Policy Recommendations to Ensure Safety in Children’s Classrooms

The components of a healthy classroom and children’s environments in general are shown in Table 3.9. While in classrooms, pupils should have protection from biological,

#### Table 3.9 Basic Needs of Pupils in Elementary Classrooms

| Provision of basic necessities | • Shelter  
|                              | • Warmth  
|                              | • Water  
|                              | • Food  
|                              | • Light  
|                              | • Ventilation  
|                              | • Sanitary facilities  
|                              | • Emergency medical care |
| Protection from biological threats | • Molds  
|                              | • Unsafe or insufficient water  
|                              | • Unsafe food  
|                              | • Vector-borne diseases  
|                              | • Venomous animals  
|                              | • Rodents and hazardous insects  
|                              | • Other animals (e.g. dogs) |
| Protection from physical threats | • Traffic and transport  
|                              | • Violence and crime  
|                              | • Injuries  
|                              | • Extreme heat and cold  
|                              | • Radiation |
| Protection from chemical threats | • Air pollution  
|                              | • Water pollution  
|                              | • Pesticides  
|                              | • Hazardous waste  
|                              | • Hazardous materials and finishes  
|                              | • Asbestos, paint  
|                              | • Cleaning agents |

physical and chemical threats and be provided with basic needs such as shelter, sanitation, ventilation, water, food, light and emergency medical care (WHO, 2010).

It is recommended that schools, in collaboration with parents, adopt safe, nontoxic methods of controlling pests to keep children out of danger. Some of the parents who are aware of the dangers related to pesticides should also initiate talks with key stakeholders to identify alternatives to pest control in schools. However, good parents will start in their homes by avoiding the use of harmful and toxic pesticides. In addition, five control measures are further recommended to ensure a threat-free environment in classrooms for children 3–5 years old, namely: control disease causing agents, provide school health services, conduct staff training on health issues, and protect children from ultraviolet radiation.

1. Control disease causing agents: Many vectors that cause illnesses are allowed to breed in school compounds and homes just due to carelessness, such as leaving bushy areas or stagnant water where mosquitoes can reproduce quite easily, eventually transmitting diseases. Klatte, Hellbrück, et al. (2010) argued that a similar trend emerges when there are waste disposal problems that attract vectors such as rats, flies and dogs. Flies can cause cholera outbreaks, whereas dogs can scare away children. The remedy for this is mainly the modification of the environments that encourage survival of insects and other vectors, which will result in illnesses, such as malaria and dengue fever, to be long forgotten. Vector-borne diseases can also be eliminated if schools and residential homes were located far away from places where these vectors breed and rest so there is no chance for interaction with humans.

In many instances around the world, the problem of organic threats is vast because children learn in facilities that are incomplete. For example, classrooms with open walls, doors or windows will allow mosquitoes an entry, and crevices in unplastered walls and
thatched roofs give the vectors a resting place as they wait to attack children. If the environment is well controlled, malaria will not be a threat to children. In addition, if malaria can be subjected to effective and prompt treatment, deaths can be reduced by more than 50%. One way to deal with this is to introduce a school health services center.

2. School health services: In areas where it is impossible to deal with all threats to children, it is recommended that schools plan to have a health service center where ill children can be diagnosed and given prompt and effective treatment. The center can also serve as the division for disease control and prevention so that pupils do not have to interrupt their learning if they are hospitalized. To make sure that the facility remains in operation, the community, parents and school management should work as a team.

Employing school nurses is a good practice, as they are able to raise any urgent health concerns observed among pupils so that these concerns can be acted on quickly. The school nurse can also refer children and even teachers to facilities and health specialists if such cases come about. Nurses would ensure regular managing cases of injuries, asthma attacks and diarrhea, as well as severe diseases such as malaria. The nurses would need good training about environmental health issues in the community for them to work effectively.

3. Staff training on health issues: Promoting health issues among staff may appear unusual, but it could of great help. In fact, all teachers working with children 5 years of age or under should have training on environmental health and basic first aid to be able to manage cases among pupils before they need to seek professional services. A competent staff will be able to notice issues in the environment that could be responsible for problems in children’s health. WHO (2010) has highlighted important things to do and to avoid in a classroom setup, especially when there is a need to conduct a practical activity with children.
of a young age. By following the suggestions in Table 3.10, staff can help reduce many classroom threats to students irrespective of the kind of interior design. For example, anything affecting inhalation or hazardous solvent products, leaded materials, cold water dyes or instant papier mâché must be avoided in children’s classrooms (WHO, 2010).

4. Protect children from ultraviolet radiation: Children can remain safe from ultraviolet rays if the school compound has many trees to provide shade and if classrooms are well built and roofed to prevent penetration. The school should also be free from surfaces that reflect sunrays because they can as well reflect harmful radiations and focus them onto pupils. Another good strategy is to prevent pupils from having outdoor events when the sun is too hot and directly overhead.

Table 3.10 Items to Avoid in the Classroom and Substitute Items

<table>
<thead>
<tr>
<th>Avoid</th>
<th>Substitute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Products that may generate an inhalation hazard (e.g. dry clay, powdered paints, glazes, pigments, wheat paste, aerosols in spray paints or fixatives).</td>
<td>Wet or liquid non-aerosol products. If dry products are used, they should be mixed while children are not present.</td>
</tr>
<tr>
<td>Hazardous solvent-based products (e.g. rubber cement and its thinner, turpentine and other paint thinners, and solvent-based markers).</td>
<td>Water-based glues, paints, markers.</td>
</tr>
<tr>
<td>Materials that contain lead or other heavy metals (e.g. some paints, glazes, and enamels).</td>
<td>Products that do not contain heavy metals.</td>
</tr>
<tr>
<td>Cold water dyes or commercial dyes.</td>
<td>Vegetable dyes.</td>
</tr>
<tr>
<td>Instant papier-mâché, which may contain asbestos fibers, lead or other metals from pigments in coloured printing inks.</td>
<td>Papier-mâché made from black and white newspaper and library or white paste (or flour and water paste).</td>
</tr>
</tbody>
</table>

3.8 Summary

In this chapter, the seven major types of children threats, i.e., thermal, chemical, electrical, physiological, emotional and organic threats, were discussed in detail. In addition, the chapter included a discussion of how these threats can be simply prevented through proper interior design, disease control, staff training and protection of children from radiation and other hazards while at school or at home.
CHAPTER 4. DISCUSSION OF SCHOOL SAFETY

4.1 Introduction

This chapter provides arguments relating to studies of school safety. This study was designed to meet the following objectives: determine the safety measures that should be considered in the interior design of classrooms for children between the ages of 3 and 5 years in addition to determining threats faced by these young children in their classrooms and how such threats affected their learning ability in schools. The discussion is organized in the form of the objectives outlined and includes the arguments outlined in the literature review and findings sections.

4.2 Threats Faced by Children 3–5 Years of Age in the Classroom

Many studies have been conducted on the threats that students are exposed to while in classrooms. The findings of this study show that students are exposed to five main kinds of threats broadly classified as physiological, thermal, biological, radiological/chemical and pollution threats. In the literature, seven major types of threats in classrooms were identified: thermal, chemical, mechanical, organic, electrical, emotional and physiological threats. This does not mean that this study concludes that some of the threats identified in the literature are not prevalent in classrooms where children 3–5 years of age learn; rather, for the present study major and related threats have been merged. For instance, the biological threats identified in this study as exposure to disease-causing vectors, such as malaria or infectious diseases and other related threats have been shown to be closely related to the chemical and organic threats identified in the literature. Organic threats increase the exposure of pupils to illness because of poor design of the classroom or building that result in conditions such as overcrowded rooms or crevices in the walls and/or the roof, whereas chemical threats are
invisible and inhaled and could cause many different illnesses, especially respiratory

disorders.

Mechanical or physical threats are common causing, for instance, cuts, bruises,
blisters and instant pain when pupils are exposed to them. Examples of mechanical/physical
threats include poorly designed staircases and chairs/desks, rough walls or floors, low objects
that can impact a pupil’s body, such as the head and slippery floors that can cause falls to
name just a few. In overcrowded rooms, which reflects a spacing problem, pupils are likely
to suffer elevated temperatures, fights with each other and even infection with communicable
diseases such as coughs or flu or even more serious diseases. As envisioned in this research
study, mechanical threats are the most common causes of injuries among children in
elementary classrooms. These include cases of hospitalization due to wounds or cuts leading
to trauma among the children. According to Docherty et al., (2006), more than 1.2 million
suffer from this threat every year with approximately 7,000 losing their lives. These findings
are consistent with many other studies. According to the Queensland Department of
Industrial Relations (2005), the U.S. health sector has noted that slips, trips and falls often
lead to major injuries, hospitalization, time off work, disabilities and, in the worst cases,
fatalities. In another study, Burgstahler (2008) concluded that many children lose the
opportunity to succeed in society because of disability or other reasons because of
mechanical threats they endured during their childhood.

In many instances, as noted by some researchers, emotional threats are not directly
related to classroom design. Docherty et al. (2006) argued that, when children are exposed to
poor interior design, they are attacked emotionally. He failed to substantiate the kinds of
interior design elements that can cause emotional trauma. As far as this study is concerned,
this threat can be caused only by other kinds of threats such as thermal, chemical, organic, mechanical, physiological or electric threats. From the findings of this study, emotional threats are common among pupils, but the actual causes are not always known, hence they are attributed to these other threats. This clearly indicates that it is perceived that other threats lead to emotional discomfort.

The fact that emotional threats are common in elementary schools (Dapi et al., 2011) indicates that there is a high prevalence of thermal, organic, electrical, chemical and mechanical threats. The finding that there is a high correlation between emotional/physiological threats and these other threats is well supported and consistent with many studies, for instance the studies by Dapi et al. (2011), WHO (2010), Sheffler (2009) and Docherty et al. (2006).

However, the present study also identified pollution as a major contributor to chemical threats, which the other main studies did not seem to associate with classroom threats among 3- to 5-year-old children. One study that recognized the dangers of pollution in classrooms, which is consistent with the present study, is one conducted by Klatte, Lachmann and Meis (2010). In that study, pollution was found to be common in many schools and responsible for a number of chemical, biological and mechanical threats. Noisy classrooms (a form of pollution due to noisy electrical or other classroom installations) could also be a source of trauma and physiological pain among pupils (Klatte, Lachmann, et al., 2010). Noise pollution also holds potential to inflict mechanical harm in that pupils may develop hearing impairments.

Dust pollution is another common problem in classrooms, especially where ventilation is a problem. Study findings by Henry (n.d.) showed that a number of classrooms
in the United States are constructed with wood and concrete floors. This means that the classrooms, unless protected, are prone to dust when children come for their lessons or leave for washrooms and return. Dust can carry many viral and biological agents that transmit diseases. Inhalation of dust also can lead to breathing problems and respiratory attacks among children. In addition, dust pollution can hinder vision, leading to bigger threats; for example, pupils could easily hurt their bodies running into objects, collide with classmates as they play and easily suffer electrical injuries because of poor visibility. Attending to this problem by creating a dust-free classroom environment during the interior design process of classroom construction would reduce these risks.

4.3 Classroom Threats Effects on Children’s Learning

A number of effects of classroom threats were identified by this study. Immediate effects were identified as feeling fatigue, getting headaches and feeling general body warmth because of thermal exposure. Students affected this way tend to be absentminded in class as well. A number of them develop a writing speed that is slower than normal.

According to Dapi et al. (2011), exposure to pesticides and other chemicals can cause mental difficulties as well as vomiting, headaches and dizziness, skin rashes and respiratory difficulties. This study showed that, in extreme cases, exposure to pesticides can be responsible for immunological problems, brain damage, nervous problems, leukemia, soft tissue sarcoma and chronic asthma. Other effects that have been identified in other studies, such as by WHO (2010), include loss of memory and ability to recall as well as autism and stunted growth.

When exposed to mechanical and electrical threats, pupils have been known to suffer physical injuries leading to disability, anemia, sight and hearing impairment and skin
disorders. As a result of these injuries, trauma and other emotional effects, such as stress, depression, lack of confidence, feeling of loneliness and lack of assertiveness, among others, develop. Klatte, Hellbrück, et al. (2010) agreed with these findings, as they argued that pupils suffering physiologically are not easy to manage because they tend to avoid their friends and often isolate themselves. They lose their sense of belongingness and hardly confront others going against their wishes in order to strike a balance.

By looking closely at these effects, it can be noted that classroom threats are not only unfortunate but also the cause of hopelessness among many pupils whose future could have been brighter. The pupils’ intellectual capability can be compromised due to a variety reasons attributable to classroom design. For instance, a pupil may tend to be absent from class at a very early age to seek medical attention. As a result, the pupil may receive lower grades and/or may finish primary education at a much older age than normal. Studies in developing countries support this finding, showing that pupils who finish their primary education at the age of 13 years (where primary education lasts 7 years) or 14 years (where primary education lasts 8 years) do not uniformly transition to high school and colleges (Brandon, 2011; Design Council, 2010; Patton et al., 2001). The pupils consider themselves too mature to continue with school and, hence, opt for other activities, especially marriage and crime. Thus, if this problem is solved early enough, during the interior design of the classrooms, pupils will not have to miss classroom instruction and, hence, will not have transition problems.

Other than the problem of transition from primary schools to high school and college, pupils suffering classroom threats can have a reduced attention span and lower comprehension of classwork. In this sense, although the pupil is attending class regularly, the performance in final examinations is dismal because he/she cannot concentrate on classwork,
because of, for instance, fatigue, high temperatures etc. When pupils don’t perform well, it is a tradition in many schools that these pupils be required to repeat the class before being promoted. To show the problem with this, Brandon (2011) lamented that repeating a class would result in many pupils losing their thirst for education because of emotional pain derived from having to learn with classmates who are far younger than they are. In these cases, the pupils may find it very difficult to express themselves and could even develop problems in speech perception and expression.

It also becomes very expensive for the parents and guardians of the pupils suffering from classroom threats to pay for medication. Problems such as asthma or cancer are locally caused but very costly to contain, especially among children. The main reason is that these ailments do not become apparent early enough for early treatment. When the symptoms start becoming apparent in children, it normally is late and the disease has often reached the chronic stage. Children might suffer from this disease for as long as they live. Visual impairment is another major threat among children that affects their performance and social life.

### 4.4 Safety Measures to Be Considered in the Interior Design of Classrooms

Many issues of interior design need to be considered to alleviate the threats outlined earlier. This study was categorical in explaining the importance of space and spacing, room size and ability to move, ability to supervise effectively, amount of fresh air through windows, natural and artificial lighting, paint and color, and flooring and ventilation issues. These issues are supported by many studies, as presented below.

First, Miller-Cochran and Gierdowski (2013) agreed that, without enough space in classrooms, pupils can be exposed to many organic and chemical threats such as contagious
diseases and high temperatures. Consistent with both the present study’s finding and Miller-Cochran and Gierdowski’s (2013) finding, WHO (2010) acknowledged that students below 5 years of age sharing an undersized room are likely to suffer high temperatures, fight with each other and even suffer infection of communicable diseases such as coughs, flu and more serious diseases. Dapi et al. (2011) further noted that classroom space should be big enough to accommodate all the pupils without any strain on their part so that learning can be conducted smoothly. Spacing, therefore, is an important factor that interior designers should consider when designing classrooms. Spacing is directly congruent with classroom movement. Poor spacing can mean minimized and suppressed movement. According to Dudek (2008), when classrooms are overcrowded, children’s potential is lost as they tend to be more aggressive and have higher chances of developing illnesses. Dapi et al. (2011) observed that the movement of elementary class pupils cannot be controlled because movement is their right. A good interior designer should take the time to know that a good design means pupils are able move around without much restriction.

For safety, ease of supervision and the comfort of the children, classrooms and other children’s settings need to be carpeted, leaving uncarpeted only the areas that are used as an entrance, playgrounds for children and other background activities. Bullock and Foster-Harrison (1997) concurred with this point of view, asserting that the interior design of classrooms should take into consideration the fact that, as a fundamental right, children need to move around, crawl, play and jump.

Another important factor outlined in this study that is still under much debate, however, is the ease of supervision of pupils in classroom. Although Zhu and Wang (2012) are of the view that the teacher’s duty is to be alert at all times to know what the pupils are
doing, some other studies have divergent views that the design of the classroom can be an obstacle to teacher’s ability to supervise. Starting with the first, i.e. the teacher’s duty to be alert, the Bureau of Labor Statistics (2012) noted that the fundamental duty of a classroom teacher is to make sure children are safe and able to learn efficiently. Supported by Gaines (2006), both studies placed most of the blame of classroom threats on the teacher. However, in reality teachers have many roles that they play. In addition to supervising pupils, teachers need to research what to teach, collect teaching and learning tools, assess pupils and do most of the clerical work, among others. Teachers, therefore, need some simplicity in their duty to supervise the pupils through appropriate design and general classroom environment. Dapi et al. (2011) are advocates of this idea and noted that a classroom interior should accommodate teachers so they don’t have to move around in order to monitor the activities of each child. The designer, according to Dapi et al., needs to make sure that different compartments within a classroom are built with half walls so that a teacher can see all of the pupils from the center of the classroom and monitor any activities happening within the compartments. WHO (2010) also recommended that separate nap rooms should incorporate low walls, between 30 and 34 inches high, to allow for teachers’ easy visual access.

From the study findings, lighting is also one of the important factors that should be observed as a safety measure against classroom threats. In fact, the interior of the classroom should be designed in such a way that there is sufficient natural light in the room during the day to eliminate the need for electrical lights that hold a further potential threat (electrical threats) during the switch on/off operations by pupils during class hours. According to PITC/CP (2008), classroom windows should be placed at a height of about 26 inches to allow children younger than 5 years of age stay connected with the outside environment as well as
to increase the amount of fresh air for ventilation. Poor lighting is closely related to poor ventilation. Children need fresh air all the time to prevent threats such as fatigue and dizziness, to which they are highly prone. A well-designed children’s facility, as outlined by Leslie (2000), will prevent air from being recycled by making sure that fresh air can always find its way into the classroom to reduce the problems related to ventilation. The children therefore stay connected to the environment around the classroom while they learn. This boosts their ability to learn faster and efficiently. Closed classrooms can function like dance halls, police cells or other poor environment, making the pupils vulnerable to exposure to threats.

Choice of color is also a very important factor in design of the interior of elementary classrooms, as highlighted in the findings and literature review. Gage (2000) categorically asserted that interior classrooms should enhance visual ability and promote memorization, as pupils learn through the use of symbols and imitation. Poor color choices can disturb the memory, hinder learning and have a negative impact on sight. Colorful wall charts, toys, materials and pictures remain distinct on backgrounds that are neutral. This helps pupils to identify and clearly distinguish objects for easy learning, as indicated in studies by Mahnke (1996), Rittner-Heir (2002) and Gage (2000). This means that the interior design of a classroom is very important. In addition to creating a visual impression for the children, the interior design is able to stimulate and streamline the learning process. For instance, a good interior will provoke the child’s imagination and foster brain development. However, when an interior is poor, children are exposed to many threats that could negatively impact their future ambitions as they remain unfocussed and disinterested in the school environment.
4.5 Summary of Research Findings

In summary, the review of previous research, drawn primarily from the United States, reveals the following key findings:

1. About 6% of business enterprises engaged in the design industry is devoted solely to interior design for spaces such as classrooms and other interiors. With more than 92% of the design business emanating from the United States, it can be concluded that the business is localized.

2. Many elementary schools in the United States start their day at 7:30 a.m. and finish at about 3:30 p.m. with two breaks: a mid-morning break and a lunch break.

3. Public classrooms with windows and doors were about 32% basic on the coefficient of variations was 30%; those with heating system and air condition system are 30% and those with electrical supply represent only about 11.9%. These public schools focused on the safety design and natural lighting design.

4. On average, about 7,000 pupils die every year because of thermal threats.
   a. More than two million people suffer serious injuries leading to disabilities of the skin, limbs and head, among other kinds of disabilities.
   b. Out of the two million serious injuries, more than 62% of the affected people are students in academic institutions at different levels.
   c. Almost half of students affect are in elementary schools (also known as primary school and kindergarten), and 28.9% of students affected are high school students.
   d. On average, the number of children 3–5 years of age who suffer serious thermal threat injuries amount to about 0.21 million annually. About three of every 100
people suffering thermal threats of interior design dies, and the rest suffer serious injuries.

5. Pupils are exposed to chemical/radiological threats because of handling electronic products such as personal computers, radio receivers, phones, microwaves, cameras and so on.
   a. Over three-quarters (78%) of children below 5 years of age in elementary classrooms in the United Kingdom have already handled computers or at least been exposed to them.
   b. The vast majority (93%) of children below 5 years of age in the United Kingdom have used microwaves and refrigerators, especially because they or their caretakers carry packed lunch to schools.
   c. Over half (51%) of children at this age in the United Kingdom have been exposed to radio waves and phones, and over a third (37%) have been exposed to other electronic devises with potential chemical threats.

6. Poor design of classrooms exposes children 3–5 years of age to air pollution, which represents a combination of biological, physical and chemical threats.
   a. Air pollution is caused by the use of poor-quality paint during interior design, displays on walls, markers, other class decorations, the classroom being exposed to dust and air due to poor acoustics and many other causes.
   b. The relationship is high between the daily temperatures recorded in the classroom and the number of children reporting cases of headaches, fatigue or feeling hot.
c. The prevalence of headaches among boys and girls occur in a ratio of 58:39, the ratio of feeling “very hot overall” was 37:21 and the ratio of feeling “very hot in head” or fatigue was 21:18.

d. Up to 62% of pupils in the elementary class-levels become absentminded and 45% develop slow writing speed due to thermal threats.

7. Classrooms designed requiring the use of many pesticides increase the chemical threat risks among schools children.
   a. U.S. elementary classrooms and toilets are constructed with the need to use pesticides to counter mosquitoes, cockroaches and other pests.
   b. Many threats among children are associated with exposure to harmful chemicals leading to symptoms such as headache, rashes, breathing difficulties, dizziness, nausea and mental disorientation.
   c. Pesticides increase the prevalence of asthma symptoms as well as immunological, neurological, respiratory and endocrine system impairments; thus, with exposure to pesticides, children could be prone to serious illnesses such as brain cancer, chronic cases of asthma and soft tissue sarcoma.

4.6 Discussion Summary

From the summary of the research findings above, a number of conclusions can be made. First, the design industry in the United States is a fairly competitive sector equipped with the necessary skilled workers and technology for the trade. Second, there are seven major threats in classrooms, including thermal/radiation threats, chemical threats, electrical threats, mechanical threats, emotional threats, physiological threats and organic threats. Thermal/radiation threats are the second most leading cause of accidents in buildings and
classrooms that culminate in deaths. Moreover, chemical threats cause injuries that have low visibility but are hazardous. Mechanical threats lead to injuries involving traumatic contact with material objects, whereas organic threats act much in the same way as chemical threats and cause injuries resulting from exposure to harmful organisms. Electrical threats arise when there is exposure to electrical current. Finally, emotional threats are exposures resulting in physiological stress and require excessive mental adjustment, and physiological threats are those that involve stress to physical body systems that goes beyond the normal limits of children.

Another major conclusion is that the effect of the above-mentioned seven threats is large, especially among 3- to 5-year-old school children. This study has revealed that the threats cause physical and emotional harm to pupils. By increasing fatigue, the threats are responsible for children’s lack of concentration and poor performance. Where permanent physical disabilities are involved, children’s future potential is diminished. There are also many health challenges revealed by the study including infection by contagious diseases and respiratory ailments, among others. Because these threats indeed negatively impact the pupil’s well-being, it is advisable that interior design processes be especially attentive to ensuring children’s safety when they use these facilities.

Among the safety measures that the study identified is proper planning during the construction of children facilities at school, for example, using recommended standards when fixing windows or installing electrical elements. This would help to reduce the occurrence of classroom threats. A number of other safety measures was highlighted in section 2.5, which focuses mainly on the construction and design point of view; section 4.7, which provides
policy recommendations on how to prevent children from becoming victims; and section 5.4, which provides an analysis and discussion of the other two sections mentioned.

**4.7 Study Recommendations**

Based on the findings in this study, the following recommendations are made, presented in two categories: the interior design industry and school management.

**4.7.1 Recommendations for the Design Industry**

The design industry comprises interior and exterior designers, policymakers and implementers. The following recommendations are specifically directed to the interior designers, policymakers and implementers.

Interior designers need to consider further training in building construction that vulnerable groups are expected to occupy. For instance, buildings occupied by children may not have the same specifications as those meant for adults and the elderly. Further training and short-term skills can make sure that interior designers understand exactly the needs of children 3–5 years of age in classrooms, hence minimizing risks related to interior design.

It is also necessary that interior designers of classrooms understand that it is their responsibility to make a classroom a safe environment for pupils all year round. This can be accomplished by following simple procedures and policies stipulated in the interior design manual for public premises meant for children. Following the simple rules could eliminate or control a significant percentage of the dangerous threats that pupils are exposed to during their learning time.

While analyzing construction plans, interior designers should become familiar with and anticipate future events in terms of economic activities, natural catastrophes, political events and even chemical activities that could pose challenges to classroom learning on the
premises. For example, some elements and metals used for classroom construction may decay later and release chemical radiation (especially isotopes of uranium) that may become threats in the classroom for students.

Interior designers charged with the responsibility of designing electrical installations should be cautious enough to use resistors that contain the effects of accidental and sudden electrical currents exposed to children. Electrical installations should also be well above the reach of the children, among other specifications.

Interior design policymakers and implementers should take an active role in the formulation of new guidelines and legislation governing the construction of classrooms as a way to minimize threats mentioned above. More urgently, legislation or policy is needed for classroom colors and roofing materials, as these pose a number of thermal, organic, mechanical, chemical and physiological threats among children.

4.7.2 Recommendations for School Managers

School managers are responsible for many of the negative incidents that happen at schools, especially those that affect the lives of children in elementary schools. They are the local policymakers and administrators and can ensure the environment is conducive to children, in regards to safety, before allowing students and pupils to occupy them. The following recommendations are directed to school managers in charge of elementary schools and kindergartens in the United States.

Members of professional interior design societies and institutions should take the initiative in contacting school managers and offering assistance in helping them detect potential classroom threats and make the completion of corrective measures a high priority.
This could, perhaps, include interior designers offering to conduct informal threat reviews of facilities in their communities.

For their parts, school managers and administrators should be sure to include proficiency in dealing with health, safety, and welfare issues as a basis for awarding interior design contracts. This study established that many schools work toward cost minimization, which, with insufficient oversight, can increase the chances of classroom threat exposure to pupils. Interior designers who are qualified to ensure high levels of school environment safety and security may not be among the lowest bidders on contracts, but if health really matters, the additional expense will be well spent.

Another recommendation to school managers is that they ought not to allow pupils in classrooms where they are sure of exposure to threat. For example, because of inadequacy of facilities amidst high enrollment, it has been a habit in many schools for pupils to be overcrowded with regard to classrooms, toilets and seating, among other elements. These are some of the causes of organic and mechanical as well as emotional threats that teachers themselves induce in pupils although these threats can be prevented. Therefore, enrollment of pupils should be according to the available facilities to ensure safety.

Many emotional and physiological threats in classrooms also have been attributed to teachers and school administrators, for example keeping pupils on one activity for long periods of time without rest or play. Studies have revealed a child’s span of concentration does not extend beyond 30 minutes of practical activities and 10 minutes of lectures. Requiring pupils to concentrate beyond these limits is a path to emotional and physiological threats, which can also be causes of other threats within the classroom. School administrators
are therefore advised to formulate their daily routines according to their respective Ministry/Department of Education’s guidelines.

Overall, interior designers, school managers, and governmental entities have a fundamental responsibility to ensure that children’s lives are the top priority, especially when cost factors impose limitations on design options. In some poor and developing countries, the government may not have the extra money to design and beautify the classroom, but they must ensure to eliminate any factors that threaten children’s lives. Their well-being must always be considered more important than anything else.

4.8 Recommendations for Further Research

This research, to identify the classroom threats to children 3–5 years of age, was conducted under the context of U.S. classroom interior design. The study focused mostly on the threats perpetrated by poor interior design of classrooms. It was found that deficits in the interior design of classrooms exposed children to many threats potentially leading to serious consequences such as poor performance, disability and death, among others. Further research is required in this area to determine the relationship between interior design and the prevalence of emotional and physiological threats to occupants (especially children), as this study could not find a straightforward correlation among these variables. Future research needs to find out why poor interior design would increase chances for emotional and physiological risks among pupils and justify why pupils in some schools that have perfect interior design still experience physiological and emotional traumas. It is further recommended that such studies conduct a descriptive survey with primary data collection in finding the correlations and regressions named above.
CHAPTER 5. ANALYSIS AND REDESIGN OF TWO PRESCHOOL CLASSROOMS

5.1 Overview

An analysis of two preschool classrooms within the Palmer Building at Iowa State University revealed a number of design problems that could result in mechanical, chemical, organic and thermal threats to the children. These problems included having trash cans with no covers, small classroom space, sharp edges on the classroom furniture and little natural light coming into the classroom. After an analysis of how the identified problems could be improved using interior design, a number of design solutions were developed for both classrooms, as they were equal in size and shape and they served, on average, an equal number of students. In the design solution, the quiet zone was enlarged to extend into the existing storage room and the active zone was also extended. A storage room was developed by dividing the observation room, which was large. The design plan classified the areas within the classroom into three areas: the messy zone, the active zone and the quiet zone. A fourth, smaller area included the entry zone. In the messy zone, the floor materials were redesigned in a way that helped in routine cleaning and cleaning up of any mess made. In the active area and quiet area, the materials also were changed. This included adding five-inch-high platforms that used vinyl resilient flooring, carpet and linoleum. In redesigning the classroom’s door, solid doors were used to prevent exposure to fire and, thus, reduce the risk of thermal injuries. The doorknob was placed at a height of over 42 inches because, in general, the height of 3- to 5-year-old children is less than 42 inches, and the shape of the knob was also designed as rounded. Both the height and shape of doorknob hardware were designed to help avoid mechanical injuries, as children could not reach the knob and, if they did, the rounded shape with no sharp edges minimized injury. Furthermore, all of the
counters and cabinets used in the preschool classrooms were reduced in height so that children could pick out items that they wanted to use, such as toys.

Sockets and switches were placed higher to protect the children from electrical shock that may result if the children played with the sockets that were within reach. The location of sockets and switches were installed over 50 inches from the ground because, at such a height, the children would not be able reach them (the highest they could reach was 50 inches). The sockets also had other safety devices. Dustbins had slowly self-closing lids to prevent injuries. The classes were redesigned using warm, natural colors, and the window was expanded and lowered enough to increase the natural light and the brightness of the classroom.

5.2 Introduction

An effective interior design often needs to be esthetic as well as functional and also must promote safety (Guerin & Martin, 2010). Nussbaumer (2004) asserted that one of the core factors in the interior design field, for instance the materials used in the internal environment as well as the style of design, is understanding how the interior design of a building promotes the safety of the people within the buildings. Arguably, one of the design factors that has been taken into consideration is how to design classrooms to make them safer for students and to promote learning (Bloom, 2013). This is even more important for younger preschool children, who tend to be curious and explorative of their environment. This analysis explored the interior design of preschool classrooms located in the Palmer Building to determine the safety issues that exist within the classrooms and how the issues can be addressed and improved through interior design.
Generally, the overall well-being of a 3- to 5-year-old child depends on diverse social, cultural, economic, health and educational factors. Socially, children need an environment that allows for creating relationships with their peers as well as adults, which leads to development of language, communication and general positive relations. Through socialization, children learn how to perform basic roles in society, but the absence of positive socialization could have a negative effect on a child’s well-being. Additionally, the well-being of a child is highly affected by cultural factors such as the beliefs, norms and lifestyles in society (Zanotti et al, 2012). Housing styles and structures are some examples of societal norms that can impact the well-being of a child. Cultural factors are important because they determine what people do and what they consider right or wrong.

A child needs an environment where there is access to quality food, clothing and sanitation, among other factors, which are only readily available when a family has money. For this reason, children from affluent families have different socialization patterns than do those who are impoverished. In addition to the influence of the environment, the well-being of a child is highly dependent on physiological and emotional factors. For instance, Bradshaw (2011) pointed out that emotional discomfort is widely known to lower concentration among children in their mid-childhood years (National Institute for Health and Clinical Excellence, 2012); resulting in such children not performing well in their academic work and other chores assigned to them.

For instance, the well-being of children can be affected by what food they eat or drink. Observing poor hygiene at meals given to children, especially at school, can be a cause of bad health among children. Ingestion of contaminated food, lack of enough food, eating too much or poor quality food is a major cause of ill health among children, for example,
obesity, malnutrition, anemia and immunity problems. In addition, children’s well-being in an educational setting, although affected by factors such as access to education resources, can be improved if the parent(s) became more interested in the child’s performance, hence overcoming many of the poor academic performance challenges.

Furthermore, as shown in Papp’s (2012) study, the well-being of children is also affected by their health and education. Health can be affected by the level of exposure of children to television programs and advertisements that often affect the mental, social and behavioral aspects of the lives of vulnerable children. In many cultures, despite having good economic standing, many mothers do not find time to socialize with their children. As a result, these children don’t get enough parental care, which can lead to delayed brain development. Similarly, some children are exposed to junk food very early in life, leading to many health challenges, especially obesity. Therefore, the overall well-being of a child depends on multiple factors including social, cultural, economic, health and educational factors. A deficiency in any of these factors can negatively affect the well-being of children.

Generally, a disorganized interior environment can often translate into a health hazard for children, as this can expose the children to physical injuries that can lead to health challenges. The causes of threats to children’s well-being can be divided into seven main categories: chemical, organic, electrical, mechanical, emotional, physiological and thermal threats.

The effect of interior design can easily be a summary of all these above-mentioned factors when applied at the school level. Many of these challenges that impact children’s well-being can be avoided by the effective interior design of classrooms. A classroom not designed to create an atmosphere conducive to learning, especially regarding emotional
aspects, can lead to children not achieving well academically. Overall, when the interior design of the classroom is not good, the children can become emotionally disturbed and, hence, concentrate poorly on class work, leading to low academic achievement. Similarly, poor interior design can lead to a classroom being unhygienic because of contamination by organisms that contaminate the children’s food and environment.

5.3 Building and Classrooms Description

The Palmer Building is on the Iowa State University campus, located between Mackay Hall and Bessey Hall and south of Lagomarcino Hall. Construction of the building commenced in 1996 and, with financial supported by Iowa State University Alumni Barbara Raeder Palmer and James R. Palmer among other donors, was completed on October 7, 2000. The building cost about $8.3 million to be built and covers an area of 34,352 square feet. The building was designed to house mainly the Department of Human and Development and Family Studies academic facilities.

The building is shared by mainly three departments: the Department of Human Development & Family Studies, IT Services Office of the Chief Information Officer, and Iowa State University General Maintenance and Services. However, the predominant department is Human Development Family Studies, with most of the ground floor in the building occupied by Child Development Laboratory School (Figure 5.1). On the east side of the building there is a parking lot, reserved mainly for the parents of children attending the school and for visitors to the building, and behind the building lies a playground, part of the school, where the young children go out to play. There are 28 rooms that house the school, four of which are classrooms and others that house administrative offices, the children’s library, research rooms, a kitchen and laundry facilities. These rooms comprise room
numbers 0351 to 0378 as shaded in the floor plan in Figure 5.1. On the east side of the building are the administrative offices, library, research rooms, laundry and kitchen, whereas on the west side of the building are rooms used for daily education, nap time and learning activities.

Licensed by the Iowa Department of Human Services and accredited by the National Association for the Education of Young Children, the lab school is both a preschool and a model of early childhood development used by the College of Human Sciences to provide university students with hands-on experience working with and observing young children. There are three main programs for the young children in the school, depending on the age of the child: a program for infants and toddlers, another for 2- and 3-year-old children, and a third for 3- to 5-year-old children. Because the focus of this study was on 3- to 5-year-old
children, the analysis of the interior design and how it affects safety issues was conducted mainly on classrooms that the 3- to 5-year-old children normally use. These are classrooms

0372 and 0378, highlighted in Figure 5.2. Furthermore, the analysis also focused on the entrance of the building and the corridor of the lab school, marked A to A2 in Figure 5.2. The door marked A is the entrance to the Palmer Building, and the door marked A1 is the entrance to the Child Development Laboratory School. This entrance does not allow everybody to enter—only this school’s children and their parents, who have magnetic stripe card or ID card to open this electronic door. If a visitor wants to visit the classroom, the teacher who stays in reception office asks the visitor to complete a registry sheet, in order to protect the children’s safety.

Figure 5.2 Location of classrooms 0372 and 0378 (shaded) and corridor (A1 to A2) in the Palmer Building
5.4 Analysis of Existing Classroom Space Elements

The focus of this analysis was to examine the interior design of the two classrooms and the corridors of the school to determine whether the interior design posed any safety threats to the children. There are seven main safety and threat issues that children may face within classrooms. These include mechanical, physiological, chemical, emotional, thermal, organic and electrical threats (Malven, 1990).

In both classrooms, there are a number of interior design elements that reduce the threats and also a number of elements that heighten the threats the children face in the classroom. Various areas and threats present in the rooms being analyzed were identified as those that highlight the core areas of safety issues and threats. These are shown in Figure 5.3, numbered as A1–A18 and B1–B18, which align with the respective photographs taken of the classrooms shown in the Appendix.
5.4.1. Main Classroom Area

5.4.1.1 Design Elements That Reduce Threats

Regarding the design elements that reduce the threats children may face in their classroom, the furniture in both classrooms, such as shelves, chairs and tables, are low and shelves and cabinets are not enclosed (A4, A7, A8, A9, A11, A12, B2, B3, B4, B5, B9, B10). Also, this furniture is made of wood and plastics that are light weight and easily movable. These factors lower the probability of mechanical threats, physiological threats and emotional threats. Furthermore, the arrangement of the work areas in circular patterns means...
that the children become engaged with each other and are thus able to be comfortable as they interact with each other (A11, A12, A13).

By keeping the shelves low and open, they are easily reached by the children who may want to access materials, such as a book, or a coat from the shelves. This lowers the probability of falls and injuries as children try to reach what they want to take. In addition, the lighter, smaller chairs are easy for the children to move around and thus prevent any physiological threats or injuries as a result of pressure or strain due to the children’s attempt to move or carry them. Furthermore, as Moxley (2003) noted, preschool classroom furniture that is low not only makes it possible for children to easily access materials used in the class but also enhances the physiological well-being of the children as they have less fear of falling from larger chairs and they feel that they are larger than the items surrounding them (Tegano, Moran, Delong, Brickley & Ramasssini, 1996). It has been shown that, when children view themselves as large compared to their environment, they tend to play for longer and quickly grasp complex games; however, when they perceive themselves as small in relation to their environment, they tend to feel vulnerable and only master simpler games (Tegano et al., 1996). Thus, children tend to seek out smaller-scale spaces, as they are naturally attracted to these smaller spaces and feel they can control them. Therefore, having smaller furniture and low-hung shelves improve the physiological safety of the children in the classrooms. Furthermore, in both classrooms the open, low-level trash cans make it possible for the children to throw away their trash without trying to open a lid (A15, A16, B15, B16), which could cause mechanical and physiological injuries if the lid bangs shut on their hands.

Unlike classroom 0378, classroom 0372 had some parts of the floors carpeted (B2, B3, B5, B10) and also had a brightly colored small couch in the middle of the room (B10,
B12, B14). These factors lower the level of mechanical, physiological and emotional threats in the classroom. Reddy, Chakrabarti and Karmakar (2012) argued that adding visual forms within a room provides a sense of harmony and balance, which can also provide a sense of stability. In a child’s classroom, visual forms may include brightly colored cabinetry with play toys or drawing materials or a brightly colored couch that gives the children a sense of home and stability. Adding a couch in a classroom, for instance, gives a sense of stability. In this sense, the couch lowers the level of emotional threats that children, especially new students, may face being in a new environment as it enhances the homey feeling. However, despite these positive interior design elements in the room that lower the threat level for children in these classrooms, other interior design elements in place do not serve to lower the threats.

5.4.1.2 Elements that Increase Threats

Despite the interior design elements that enhance the safety of children in the classrooms, there are other factors that heighten the threats for the children in the classroom. The first thing one notices when entering either classroom is the dim, shaded light and the lack of natural light (A4, A6, A9, A13, B2, B4, B5, B6 and B14). The amount of natural light coming into classroom 0378, as noted by A14, is not enough to extend into the entire classroom. However, unlike classroom 0378, classroom 0372 has more potential for natural light upon entering the classroom as can be noted by the wider wall-sized windows in image B4. This means that, although the design element can still be improved by a large degree in order to reduce emotional and chemical threats through secretion of important hormones or enzymes, largely classroom 0372 has far better natural lighting than does classroom 0378. Webb (2006) argued that natural lighting is an imperative for students in a classroom as it
influences their physiological processes such as the secretion of certain hormones and the regulation of body temperature, which has implications for wake and sleep states, mood changes as well as the ability to be alert.

Furthermore, for a preschool classroom, having a well-lit room, especially using natural light, is imperative to enable a good attention span by students in the classroom. Webb (2006) noted that lighting within a room, especially natural light such as sunlight, has a strong impact on the physiological processes of human beings. Natural light tends to influence and control the secretion of certain hormones as well as body temperature, which has implications for wake and sleep states as well as mood changes and the ability to be alert. Thus, a classroom needs to have well designed openings that control and enable natural light to come in.

Classroom 0378 also lacks lots of pictures and brightly colored room or wall charts (A9, A5, A10, A11, A12, A13). Moxley (2003) argued that displays on the wall have to be colorful, fun and welcoming for the young children to reduce anxiety for those separated for the first time from their parents and the windows need to be wide and expansive to give an illusion of a wider room. However, this is not so in this classroom. Cliff and Chabaneix (2008) noted that core physical factors of an interior that interact with a child’s attitude and emotional state within a classroom are color, texture and material forms within the classroom. Thus, without effective focus on and attention to these elements, the child’s emotional safety is lowered as the lack of these elements heightens environmental stressors, increasing anxiety in the children (Malven, 1990; Piotrowski, 2004).

Another threat from the interior decor of the room is the general color of the classrooms, which are not brightly colored and which may also influence how safe and
productive a child is in the room (B2, B3, B4, B15). Read and Upington (2009) asserted that kindergarten children on average prefer red and blue colors in an interior environment and that girls also preferred purple. It is imperative that color within the interior environment be taken into consideration in a child development environment because it plays a big role in enhancing children’s highly imaginative minds and, thus, makes them happier, which in turn lowers emotional threats within the classroom.

Other design elements observed in classroom 0378 that may be a threat to children include the hard floors, which increase the risk of mechanical injuries in the case of a fall (A9, A10, A1, A12), Hoppen et al. (2000) noted that for classrooms, especially those for younger children, the use of softer textured materials and carpeting is imperative in preventing mechanical and physiological injuries due to tripping.

Another safety issue noted is the electrical threat created by the exposed wires and sockets that children can reach and which can potentially be dangerous (B1, B5, B6, B7, B8) and low hanging electrical wires from the teacher’s computer desk, which are an electrical threat to the children (A5, B8). Although part of the wiring is covered in classroom 0372, (B8), the wires connected to the computers are low and children can easily reach them (B7, B8). Furthermore, Moxley (2003) argued that all electronic wires and sockets in a kindergarten classroom need to be covered or placed higher than the children can reach. These factors need to be taken into consideration in order to ensure the safety of the children.

Furthermore, while there may be a risk that the children would play with the open trash cans (A15, A16), it is imperative that the rubbish thrown in the cans is not organic or chemical in nature in order to lower chemical and organic threats. For both classrooms, the least of threats were organic, chemical and thermal threats. The materials used in the classes
are of good quality and do not present any thermal threats as there are no flammable materials used in the room. Furthermore, although there may exist a small risk in terms of a chemical threat due to factors such as allergic reactions to the materials the students are using, the chemical threat is greatly reduced given that no materials, such as plastics and toys, contain harmful substances such as lead. This is also the case with organic threats.

5.4.2 Restroom

A restroom is located within each of the classrooms. The toilets are smaller and lower, thus decreasing the risk of mechanical and physiological threat, as children can develop a fear of falling from a higher toilet seat (Vernon, Lundblad, & Hellstrom, 2003). The lack of a closing lid for the toilet also protects the young boys in the classroom from having the toilet lid bang into them as they are using the toilets (A17, B17). Glass et al. (2013) noted that over 81.7% of toilet seat crush injuries among young boys occurred among those 2–3 years of age and resulted in genito-urinary injuries due to penile crushing by the toilet seats. Thus, not including toilet lids protects the children from mechanical and physiological injury.

The location for the toilet inside the classroom enhances the comfort and safety of the children, as they can easily excuse themselves to go to the toilet (A17, B17). Moxley (2003) asserted that having toilets in the classroom lowers fear for youngsters when they are pressed to go to the bathroom, and further, having toilets in a position where no adults can use them and where they can be easily cleaned out also protects the children from organic threats.

Although for both classes there is some probability of an organic threat emanating from the uncovered toilets as they are being flushed, for the most part the bathrooms and toilets are clean and are used only by the children, thus lowering the risk of organic
infections in the classrooms. The presence of sinks in the bathrooms ensure that the children have the opportunity to wash their hands after visiting the toilet in order to avoid transfer of any germs, and the lack of a lid on the toilet means that physical contact with the toilet by the children is minimized, thus minimizing organic threats (B17, B18).

5.4.3 Corridor

The corridor (A1, A2, A3) is wide enough to allow for effective movement, especially for young children who tend to run down corridors. This width lowers the level of mechanical and physiological threats through possible blunt trauma that may occur against the walls as the children run. However, the bench along corridor A2 and A3 poses a mechanical risk to children because of its sharp instead of rounded edges. This increases the risk of the children suffering blunt trauma if they fall and hit themselves against the bench. Moxley (2003) asserted that pieces of furniture within a kindergarten class, including drawers and tables, among others, need to have smoothly rounded edges for safety. Although most of the furniture in theses classrooms has rounded edges (A5, A9, A12, B7, B10), the bench along the corridor does not, thus increasing the threat of harm for the young children.

5.4.4 Classroom Size

5.4.4.1 Description

Based on the original floor plan, as illustrated in Figure 5.4, the two preschool classrooms are adjacent to each other and are almost the same size. Classroom 0378 is 1,047 square feet in size, whereas the second classroom 0372 is 1,044 square feet in size. Within classroom 0378, room 0378A is a 100-square-foot storage area and room 0378B is a restroom within the classroom measuring 92 square feet. In classroom 0372, the
Figure 5.4  **Floor plan for the two classrooms**

measurements of the storage room and restroom are also almost the same: The storage room is 100 square feet, whereas the restroom is 87 square feet.

Each classroom houses, on average, 22 students. Olds (2001) asserted that most states require that there be a minimum of 35 square feet of activity space for each child in a classroom, and where conditions permit, it is even better if the active space per child is 50 square feet. This is imperative in both helping to prevent injuries and in providing a larger active space, which enhances exploratory learning for young, curious children (Moxley,
The room has a lot of furniture in the form of cabinets, chairs, tables and counters that also take up space within the room.

As shown in Figure 5.5, counters can be made as open shelving or closed doors. The shape of the counters and presence or absence of doors can significantly alter the perception of the children’s living and learning space and determine its use and location. A counter with doors gives the perception that there is less space because the inside space is not readily accessible; a counter such as this is located in the lower right corner of the entry zone for storage purposes. A counter without doors is located in the quiet room for temporary storage of reading materials.

**Figure 5.5 Examples of counters with and without doors**
(a) Counter with doors; (b) Counter without doors (Source: Arizona State University, 2011)
5.4.4.2 Threats

Miller-Cochran and Gierdowski (2013) stated that the size of a classroom should be big enough to accommodate all the pupils without any strain on their part so that learning can proceed smoothly. A smaller space limits movement by the children, thus being a threat to both their emotional and physical well-being. Enough space for movement in a classroom helps pupils discover their potential and what that they are capable of doing, hence leading to good physical and emotional growth. Otherwise, children might be deprived of their right of a good self-concept and personal identity (Samuels, 2007).

With 22 children in each class, each classroom requires about 770 square feet of active space that is not occupied by other things in the room. However, based on the space in these rooms and the furniture present, the rooms were shy of the 770 square feet of free space. An interview with the teachers in the classrooms revealed that they felt that the free space in the classrooms was small for the children and tended to result in a crowded effect. Due to their very close proximity to each other, the children can easily get into disputes and some may get injured. Dudek (2008) acknowledged that an overcrowded classroom can lead to pupils being too aggressive to foster good relations, and such a room increases the chances for illness among the children. Thus, it was imperative that the spaces be redesigned, not only to increase space available to the children but also to eliminate the threats that are present in these classrooms.

5.4.5 Activity Areas

5.4.5.1 Description

Both classrooms have different activity areas: an active zone, a quiet and a messy zone, as highlighted in Figure 5.6 along with the arrangement of the furniture in the rooms.
For both classrooms, the quiet zone is the smallest of the three areas in the classroom and the active zone is the largest. Although this is an ideal condition for most preschool classrooms (Olds, 2001), the problem with the two classrooms in question is that the effective active area within the rooms is less than 770 square foot due to the large number of items in the rooms. Within the active areas of the classroom, counters and cabinets are used to divide the different areas, which may be unsafe and not needed. Within the quiet zone, the bookshelf and the computer table take up a large part of the space, thus the children do not have a quiet area where they can rest, read or listen. This was the same case in the messy zone, where much of the space is taken up by cabinets, chairs and tables, which greatly limit the

Figure 5.6  Layout of the classrooms indicating different areas within the rooms
movement of the children in the rooms. Floor plans need to be considerate of the intended activities upon completion so that enough space is allowed for that purpose (Feinberg & Keller, 2010).

5.4.5.2 Threats

For both classrooms, the entry zone was about 20 square feet in size, which is on the small side relative to the activities engaged during entry to the classroom. Olds (2001) mentioned that the entry zone should provide an enough space so that adults can sit to remove children’s outer clothing and their own shoes. However, the entry zone in these two classrooms was only an aisle and not spacious enough to handle such activities efficiently.

5.5 Interior Design Analysis Based on the Open Classroom Design Principle

5.5.1 Meaning of Open-Classroom Design Principle

A classroom design has to follow some principles and standards to make sure that it is suitable for children in elementary classes. One such principle is that of an “open classroom.” For young children, the principle of an open classroom is interpreted to mean that pupils are provided more opportunities to explore their learning environment. Using this principle, a classroom interior is designed with the seating arrangement not in rows. According to Izadpanah (2011), a row-seating design denies pupils the freedom they need to move around and be physically active. With the open classroom design principle, if used as intended by the pioneers, the greatest portion of children’s instructional time is spent writing, and they are at their desk for a specific period until break time (see Table 5.1). Areas that lead into the traditional classroom are strategically blocked off using cupboards or bookshelves in the space. However, if furniture is not well arranged, there can be a big problem with teacher
coordinated. An effective utilization of the principle leads to the attainment of activities that follow a typical learning time.

**Table 5.1 Percentage of Time Pupils Spend on Tasks in Open-Plan Classrooms**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Percentage of time spent on activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Writing</td>
<td>26.0</td>
</tr>
<tr>
<td>Arts and crafts</td>
<td>11.8</td>
</tr>
<tr>
<td>Talking</td>
<td>11.3</td>
</tr>
<tr>
<td>Reading</td>
<td>6.3</td>
</tr>
<tr>
<td>Working on projects</td>
<td>5.7</td>
</tr>
<tr>
<td>Teaching</td>
<td>4.3</td>
</tr>
</tbody>
</table>


This design principle suggests that partitions used in the interior design of classrooms should be adjustable to allow children of all heights to see outside so that they can stay connected with the outside environment. One advantage of open classrooms is that pupils accomplish their learning activities in less time, especially when they are directed (Klatte, Lachmann, et al., 2010). To make sure this happens, it is recommended that children be kept in contact with some visual elements as other activities continue but maintain some form of privacy for individual or group activities. Privacy should be minimized as much as possible because, according to the research of Meggs et al. (2012), nursery, preschool and Montessori children prefer activities done in social contexts rather than in privacy and small activity spaces. Thus, partitioning should be restricted only to activities where children are not able to control themselves effectively.

Research also has established that urban schools do not do as well with the open classroom design as suburban schools do. However, success or failure of this interior
classroom design depends on the style of the teacher, whether lecture or interactive oriented, the age of pupils, problems in attention span and any learning disabilities. Nevertheless, this interior design standard is associated with many challenges, especially too much noise and too many distractions and, finally, open classrooms may not really foster adequate academic benefits to counter the problems experienced with the design. An important note is that, if the ultimate goal or measure of a particular classroom interior design is academic performance, then the traditional design works better. However, if measures of a successful classroom design include aspects such as learning social responsibility, learning how to learn or acquisition of cultural and moral values, the open classroom interior design can score quite high marks.

5.5.2 Interior Design and Children’s Stimulation in an Open Classroom

The form of interior design should always help stimulate pupils to learn something new. The level of stimulation can be influenced by wall displays containing exciting and interesting objects, making the room a complex environment. The level of wall-oriented stimulation should be monitored, because too much on display can lead to an overload of information to the children, whereas too little can make students feel bored or under stimulated. Although a complex environment arguably may provide more interesting materials for children’s learning, but potentially lead to overload (Samuels, 2007; Sheffler, 2009; Soegaard 2012), a simple environment can provide less opportunity for children and hence lead to distraction. However, research by Sparke, Wealleans, Keeble and Martin (2009), who examined about 120 preschools, revealed that there was greater learning achievement in less complex learning environments.
Thus, it can be concluded that the main problems of classroom design in terms of children’s stimulation is overload and distraction, which can be avoided through effective interior design. According to Moretti and Conte (2012), such problems can be avoided through the interior design of three types of walls: acquisition, maintenance and dynamic walls. Acquisition walls are those that are placed at the front of the classroom, for example on which the blackboard or class notice board is placed. These can be effective in showing new concepts or concepts that the children are struggling to learn. Maintenance walls are placed on the sides of the classrooms, generally to show information that is being reinforced so that children can fully understand learned concepts. Dynamic walls, on the other hand, are placed at the back of the room and contain other decorations such as temporary notices and pupil’s work.

5.6 Classroom Noise and Space

In this study, noise and space were two of the interior design elements that were analyzed.

5.6.1 Noise and Classroom Interior Design

Noise can gain entry into classrooms due to a lack of effort to design classroom walls correctly. Noise is a big problem in schools that are located in busy environments such as near airports, highways or industrialized locations. Research has been conducted on noise and its effect on learning.

In one study, it was found that loud noise impairs intellectual performance on complex tasks, even when there is a feeling that pupils have adjusted to the noise. Cohen, Glass, and Singer (1973) found that elementary school children going to school near the Los Angeles International Airport, where the noise level is approximately 95 dB, performed
poorly in simple tests compared to pupils in schools located in less noisy areas. The two
groups of elementary school pupils (3–5 years of age) were matched in terms of age,
ethnicity, race, hearing loss and social class. The results showed that children in the noisy
schools near the airport had higher blood pressure, were more distractible and had more
difficulty dealing with complex puzzles and mathematics problems than did children in less
noisy schools. Pupils from the noisy schools, upon being given a solvable problem, were less
likely to solve it, whereas there was an attempt by a majority of elementary school pupils
from quieter places. It was also noticed that children from noisy schools gave up quite easily
when solving problems and were less likely to take advantage of the choices offered.
Moreover, they did not get used to the aircraft noise and became very distractible. Living in a
noisy environment makes it impossible for children to distinguish between a relevant task
and irrelevant noise.

Another study, by Bronzaft and McCarthy (1975), revealed there was a variation in
the academic achievements of children taught on opposite sides of the same school where
one side faced a railway. From the analysis, it was found that up to 11% of learning time was
lost as trains passed and the general reading capability was lower. This research prompted the
government to make acoustically treated walls and ceilings in the classrooms and noise
absorbing pads along the railway track to harmonize learning achievements in all classrooms.
Indeed, there was recovery in reading and writing achievements among all the children
(Bronzaft & McCarthy, 1975). Noise, therefore, can be a great risk and threat to children 3–5
years old.
5.6.2 Personal Space Design for School Children

It was already noted that space within classrooms is very important for the well-being of children. Adequate space allows each individual in the classroom some allowance for movement, jumping or walking, activities that children 3–5 years of age enjoy. Adequate space also allows for good interaction between children and their teachers. When the interior design of a classroom does not consider provisions for space, there is likely to be a problem in how pupils grasp knowledge. Interior designers also need to check for the right measurements of the height and width of equipment such as blackboards, notice boards, teachers’ stands and where children sit. Design and Construction Services (2004) has provided a formula on how to determine the space needed between teachers and their pupils in order to achieve some objectives (see Table 5.2).

<table>
<thead>
<tr>
<th>Distance</th>
<th>Appropriate relationships and activities</th>
<th>Sensory qualities for children</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1.5 ft:</td>
<td>Intimate contacts, physical sports</td>
<td>Touch is the main means of communication; intense sensory awareness</td>
</tr>
<tr>
<td>intimate distance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5–4 feet:</td>
<td>Close friends or acquaintances</td>
<td>Visual and verbal communication</td>
</tr>
<tr>
<td>personal distance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4–12 feet:</td>
<td>Impersonal, business-like contacts</td>
<td>Less detailed visual communication; normal voice level; touch not possible</td>
</tr>
<tr>
<td>social distance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;12 feet:</td>
<td>Formal contacts, e.g., as in a lecture between student and lecturer</td>
<td>No detailed visual communication (VC); exaggerated non-verbal behaviors to replace the subtle non-VC of closer distances</td>
</tr>
<tr>
<td>public distance</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


The concepts of personal space and territoriality have been applied to the interior design of learning environments. Generally, interiors for classrooms meant for elementary children are supposed to enable a close proximity between pupils and the teacher, probably
intimate or personal according to the guidelines shown in Table 5.2. This encourages students to gain a feeling of affection from their teacher, hence leading to good academic performance. This is because a teacher can establish one-on-one interactions with the pupils. Close proximity allows pupils to feel affection, trust and intimacy with their teachers; otherwise this close distance would really frighten the pupils.

Feinberg and Keller (2010) found in their research that pupils sitting in the middle front sections of a class fared better and that there was a positive relationship between where pupils sat and how they participated during class learning activities. Sitting in the center at the front promotes verbalization, except for very low verbalizers; facilitates good attention; and finally, improves grades of pupils at their early stages of education (Gaines, 2006). The knowledge of space from this research should guide interior designers in terms of, for example, seat arrangements that would place weak pupils in the front rows to be able to benefit from the personal distance.

5.7 Classroom Learning Center Spaces and Placement Analysis for 3- to 5-Year-Old Children

5.7.1 Description

How children relate to classroom space depends on the interior design of the different activity centers of the classroom. A classroom is composed of many centers, but this analysis focused on just a few. Generally, learning centers in a classroom can be defined using low open shelves on three sides, probably at sides and the front of the learning center. One basic concept is that block and dramatic play centers are supposed to be large enough to accommodate at least three children playing and building sizable structures with blocks. Good learning centers should be designed like a “maze,” according to the Picard Center (2005). Second, all learning center materials should be labeled using words and pictures so
that children can grasp the meaning and function quite easily. Although not widely used, learning centers that include environmental print throughout the classroom are the most appropriate. In a classroom, the designer, in collaboration with the teacher, should incorporate diverse materials throughout the environment throughout the school year with the objective of maintaining children’s interest throughout the year (Design and Construction Services, 2004).

One of the centers in a classroom is the art center. Because the art center should be located near a sink, classrooms should be designed with a sink and source of water. Whether or not a sink is available, an art center should contain a variety of art materials, such as drawing materials, paint materials, three dimensional art materials, tools and collage materials, as well as art materials and supplies that are related to other classroom experiences, i.e., theme-related materials. Such materials, according to the Picard Center (2005), should encourage individual expression. Furthermore, they should be offered at different levels of pupil ability. For instance, scissors cannot be offered to very young children and paintbrushes can be misused by some children if they are not supervised, especially for those children who are three years of age or younger.

Another classroom center is the block center. The key design principle in this case is to allow enough space for at least three children to build sizable structures. At the same time, the block center should be away from traffic, preferably in a corner of a room defined by low shelves, and should offer a variety of blocks, for instance wooden or plastic unit bocks, homemade blocks and large hollow blocks (Design and Construction Services, 2004). In addition, the block center should be near other noisy activities, such as the dramatic play area, as mixing them with quiet activities, such as reading, could be disruptive. Like the
design of the art center, the block center should include appropriate materials, and the
designer should make sure that some block materials are related to other classroom
experiences, i.e., theme-related materials. However, the use of other material not related to
block play should be limited in this center.

The dramatic play center is another area that requires good input from an interior
designer of children’s classrooms. The center should be clearly defined as a space to play and
have organized storage, enhanced with props that encourage a variety of themes such as
leisure, kinds of work, housekeeping and fantasy. As already mentioned, it is good to arrange
for some dramatic theme-related play materials that relate to other classroom activities.

5.7.2 Safety Considerations

There are other considerations for classroom space design, including classroom
proportions, an important task for the interior designers (Arizona State University, 2011). In
terms of classroom proportions, designers should ensure that all seats are located within a 90-
degree viewing angle from the center of the projection screen or blackboard in the classroom,
that is, within two 45-degree horizontal angles from the perpendicular to the center of
screens. Similarly, it is important to have classrooms narrow enough to permit all seats to be
within the 90-degree viewing angle from the front wall (Picard Center, 2005); however, it
should not be any narrower than necessary. Rooms that are too narrow and deep make it hard
for pupils and their teachers to interact at personal and intimate distances. For the design of
the front of the classroom, interior designers in collaboration with exterior designers and
architects should make sure that the distance from the front wall to the first row of seats is
about one to two times the height of the projection screen. Typical screen height in a flat-
floor classroom, according to Design and Construction Services (2004), is 8 feet; therefore, the first row of seats should preferably be 10–12 feet away from the front wall.

In addition to this, classrooms with multimedia outlets should consider having a reading stand placed to one side of the front teaching wall, which would leave an unobstructed view of the writing surface and projection screen for the pupils, and the media technology should be installed either in a bookstand or rack near the stand. Furthermore, the projection screen, as suggested by Arizona State University (2011), should be placed to allow at least a 6-inch-wide portion of the writing surface to be visible whenever the screen is lowered. Placing the screen at a slight angle in the corner opposite the instructor lectern works well for classroom multimedia displays. There should also be consideration for space to allow for movement of the teacher and the teacher’s table, which should generally measure 48–60 inches wide by 24 inches deep. In addition, in a typical classroom a chair must be provided for the instructor to allow for marking of assignments. However, when a class is generally practically oriented, there is no need for a chair.

Although not always directly related to interior classroom design, it is good to understand a few basics about classroom placement. The general standards are that general assignment classrooms need to be located as close as possible to the main building entrances in order to limit travel through the building by the pupils during class hours. This is especially important for classrooms with large capacities. It is also wise to keep classrooms grouped together on the same floor. Moreover, classrooms should be located far away from noise-generating equipment and activities, including mechanical systems, elevators and restrooms. Because it is not easy to eliminate noise from children’s classroom, all learning centers need to be designed with noise buffers to prevent classroom disruption during
learning activities. Young children will often need rest, thus resting rooms should be near classrooms. However, the two facilities should have to share a common wall (Design and Construction Services, 2004).

It is also important for designers to realize that not all children have the same abilities; some could have mental or physical disabilities. Hence, accessibility for all children should be considered during design, and the design of classroom elements, for instance lighting, entry doors and seating, should be designed with an allowance for specialized equipment for children with disabilities. For example, there could be the need for a separate light for a sign language interpreter, which must be placed near the front of the classroom. Additionally, this light should not spill onto the projection screen, and its control may be located with other controls at the lectern (Picard Center, 2005).

5.8 Design Project

5.8.1 Introduction

This section provides an analysis of the preschool classrooms in the Child Development Laboratory School. A development laboratory for children refers to a facility that enables children grow sustainably by learning through observation and modelling; thus it needs an interior design that connects the children with the environment through the choice of color and shapes. As mentioned earlier, the general design for the school comprises four unique classrooms, i.e., room 0356 for infants, room 0362 for toddlers and classrooms 0372 and 0378 for preschool children. The focus of this analysis was on classrooms 372 and 378, the floor plans of which are shown in Figure 5.7. Room 0378 is 1,047 square feet, within which 0378A (a storage area) is 100 square feet and 0378B (the restroom for the class) is 92 square feet. Room 0372 is 1,044 square feet, also with a storage area (0372A) of 100 square
feet and a restroom (0372B) of 87 square feet. Each classroom houses 22 pupils and is enriched with enough facilities, for example cabinets, counters, tables and chairs, for those students.

Generally, the state requires that activity space for each child be at least 35 square feet and that active space be a minimum of 50 square feet (Olds, 2001). This means that, for 22 pupils, a total of 770 square feet of active space is required. Therefore, analytically, these classrooms do not meet the standards for space.

The key complaint with these classrooms was that they seem overcrowded because they are smaller than the minimum standards. This could lead to greater chances that children have disagreements with one another and occasionally sustain physical injuries. Therefore, this was a matter that needed urgent attention through expansion of the rooms, changing of their layout or building new rooms.

The classroom layout for room 0378 clearly shows that different areas are uncoordinated and out of proportion. The quiet zone is the smallest and the active zone is the largest, which is appropriate. However, the layout vividly shows that the predominant feature in the classroom layout is the chairs and tables, which is quite inappropriate. The active area, despite being the largest and comprising about 770 square feet, seems to be overcrowded with furniture. Because of this crowded situation, it is quite easy for children to sustain injuries caused by the room facilities, such as counters and cabinets, which have been used to divide space there. In analyzing the quiet zone, it was found that this area also seems to be overcrowded by tables and bookshelves which consume a great deal of space. Thus, children
Figure 5.7 Original preschool classroom floor plan for the lab school

Quiet zone, entry zone, active zone, observation zone, messy zone, restrooms and storage rooms are shown. The messy room is located near the rest room and farther away from the entry zone for purposes of the children’s safety. Active zones are also isolated and designed with bigger openings to connect children to the external environment for and to eliminate extreme thermal threats and enhance safety.

22 pupils shared a 1,044-square-foot classroom containing stairs and a ramp, which are unnecessary and dangerous for children.

22 pupils shared a 1,047-square-foot classroom containing lots of tables, chairs, counters and educational materials. There is not enough space for children to play and learn.

would have difficulty accessing a quiet environment for their reading, resting and listening needs. The entry zone is just about 20 square feet, which seems too small for the needs of the
According to Olds (2001), an entry zone should be big enough for children as well as for adults to perform their duties such as changing clothes and removing shoes for children and themselves. However, this was apparently ignored in the design and layout of this the entry zone, which was constructed similar to an aisle. The design and layout of an improved classroom in place of classroom 0378 is shown in Figure 5.8.

**Figure 5.8 New design layout for classroom 0378**

The room has various designs elements that resemble nature, for example bean-shaped tables and a cloud ceiling that not only enhance safety from physical threats but also keep children connected with nature. (Source: Design and Construction Services, 2004)

In this improved interior layout and design, there are still four main parts of the classroom: entry zone, messy zone, quiet zone and active zone. In the preschool classroom,
the most important area is the active zone. Children 3–5 years old need enough space to move, without which they could become frustrated. The second most important area is the quiet zone. Recognizing that the energy of preschool children is limited and they can become tired and sleepy, they need a quiet environment where they can take a break and read, listen or rest. A description and discussion of each of the redesigned areas is provided to enhance the understanding of the improved classroom design.

5.8.2 Entry Zone

5.8.2.1 General

The entry door is a solid door, which is important to prevent fire and thermal-related injuries. The door knob is placed higher than 42 inches from the floor (Figure 5.9), in consideration of the fact that, generally, the height of children 3–5 years old is approximately 42 inches; thus the knob at this height can help to avoid threats, especially mechanical injuries. The transparent opening (covered with glass) is lowered to below the reach of children to protect them from physiological threats (Design Council, 2010). The door is made of wood, which is appropriate for children, as it makes them feel as if they are in their own homes with their family members, reducing the chances for emotional disturbance among children who may feel homesick. As recommended for all preschool doors, this door has a slow-closing device and rubber gaskets on the edges to prevent pinched fingers as well as to reduce other threats such as noise (Figure 5.9).

The entry zone floor is made up of vinyl flooring, which sends the message that people entering (child or adult) should take off their outerwear and shoes. That also means that the area can easily get dirty. Vinyl flooring is easily cleaned and durable. Although the floor material should have some texture, the surface should be a little rough for two reasons.
First, the roughness prevents children from falling down, thereby reducing mechanical injuries. Second, smooth flooring would reflect light within the classroom, an aspect considered a poor design standard because reflection can damage children’s eyesight, increasing the risk for physiological threats.

The identification of, analysis of, and solutions for the entry door problems are summarized in Table 5.3 and illustrated in Figure 5.9.

Table 5.3 Entry Door Problems Identification, Analysis, and Solutions

<table>
<thead>
<tr>
<th>Problem: Entry Door</th>
</tr>
</thead>
<tbody>
<tr>
<td>☒ Mechanical Threat</td>
</tr>
<tr>
<td>☒ Physiological Threat</td>
</tr>
<tr>
<td>☐ Organic Threat</td>
</tr>
</tbody>
</table>

Analysis: Entry Door

Mechanical & physiological threats: Design of entry door

- Children can easily reach the door knob. While they playing, the door knob can be a dangerous factor leading to mechanical injuries.
- Although the door had a slow-close device installed, it also closed fast and loud. Children’s fingers can be pinched when a door closes suddenly, causing mechanical and physiological threats.
Table 5.3 (continued)

**Solution: Entry Door**

<table>
<thead>
<tr>
<th>Solution Concept 1: Mechanical problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>• The height of the knob should be over 42 inches, as generally, the height of children this age is less than 42 inches. The higher knob helps to avoid it hitting their heads.</td>
</tr>
<tr>
<td>• A spherical knob can reduce the severity of a mechanical injury if a child’s head bumps into the door knob.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Solution Concept 2: Mechanical and physiological problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Rubber gaskets can prevent a door from closing suddenly. When a door closes slowly, it avoids the pinching of fingers and the noise of sudden closure, thus preventing mechanical and physiological injuries.</td>
</tr>
<tr>
<td>• A slow-close device uses the pressure principle to slow down the door’s closure. When a door closes slowly, it avoids the pinching of fingers and the noise of sudden closure, thus preventing mechanical and physiological injuries.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Solution Concept 3: Emotional &amp; thermal problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>• A solid wood door providing a feeling of home for children. It can reduce the chances for emotional disturbance among children who may feel homesick.</td>
</tr>
<tr>
<td>• During a fire, a solid wood door is relatively safe, which can reduce the risk of thermal injuries.</td>
</tr>
</tbody>
</table>
Table 5.3 (continued)

<table>
<thead>
<tr>
<th>Solution Summary</th>
</tr>
</thead>
</table>
| • The spherical knob can minimize injuries even if the knob hits a child.  
  • Rubber gaskets and a slow-close device can prevent the door from closing suddenly. A sudden closure can easily cause injuries for children, such as their fingers, and can cause a loud noise, which can scare children.  
  • A solid wood door is relative safe in the case of a fire threat as it can isolate the thermal threat. |

BEFORE

![Before Image](image)

Figure 5.9 Entry door for classroom 0378
Figure 5.9 (continued)
5.8.1.2 Safety

A cross section of the entry zone showing the safety measures taken to protect children as they use the facility is shown in Figure 5.10. The identification of, analysis of and solutions for the entry door problems are summarized in Table 5.4. The threats are reduced through the availability and arrangement of facilities, such as cabinets to store shoes to protect from biological threats, and a couch and counters, etc. for other related safety precautions (Piotrowski & Rogers, 2010).

This zone contains cabinets, counters and cubbies with seats. The counters are about 6–10 feet long, about 36 inches high and 24 inches deep. Children can use the space under the counters to store their shoes and personal items. The counter can also be used as sign-up table. The cabinets are 6–10 feet long, about 30–42 inches high and about 12 inches deep. These cabinets can be used by the students to store their personal belongings as well as by

<table>
<thead>
<tr>
<th>Problem: Entry Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>☒ Mechanical Threat</td>
</tr>
<tr>
<td>☐ Thermal Threat</td>
</tr>
<tr>
<td>☒ Electrical Threat</td>
</tr>
<tr>
<td>☒ Physiological Threat</td>
</tr>
<tr>
<td>☐ Chemical Threat</td>
</tr>
<tr>
<td>☐ Emotional Threat</td>
</tr>
<tr>
<td>☐ Organic Threat</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Analysis: Entry Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical Threat: No cabinet doors</td>
</tr>
<tr>
<td>The lack of cabinet doors can cause the mechanical injuries for children. The exposure to items can easily trip children while they are running or walking. Falling items also can cause blunt trauma for children.</td>
</tr>
</tbody>
</table>
Table 5.4 (continued)

<table>
<thead>
<tr>
<th>Electrical Threat: Socket and switch placement</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Sockets and switches should be covered whether or not they are working. Exposure to sockets and switches is an existing electrical threat for children in the classroom.</td>
</tr>
<tr>
<td>• The height of the sockets and switch makes them easily reachable by children, which is a dangerous electrical threat for children.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Physiological Threat: Counter and cabinet size</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Unsuitable size of counters and cabinets can affect children’s skeletal and muscle development. It can cause the physiological injuries for children.</td>
</tr>
</tbody>
</table>

**Solution: Entry Zone**

**Solution Concept 1: Mechanical problem**

| Collapsible hooks are suitable for children’s use; when children want to hang their clothes or items, they just need to pull it out. During free time, the hook can hide in the slot, which can prevent mechanical injuries. |

**Solution Concept 2: Electrical problem**

| Guards can cover the sockets and switch the whole time in order to prevent children from touching the electrical fixtures. This can minimize electrical injuries in the classroom. |
| The height of sockets and switches should be greater than 50 inches from the floor in order to prevent children from contacting the electrical fixtures. |
### Table 5.4 (continued)

#### Solution Concept 3: Physiological problem

- These cubbies with seats are used for children to store their shoes, clothes and personal items. The lower 11 inches of the cabinet provides seats for the children to take off their shoes and outerwear. The total height of cubbies is 48 inches, which the children can reach easily. This can prevent physiological problems.

#### Solution Summary

- The cabinets should have doors in order to prevent items from falling, which would cause mechanical injuries for children.
- The socket and switch guards are necessary to prevent children from contacting the electrical fixtures.
- Sockets and switches should be installed at a height greater than 50 inches, a height that is relatively safe for 3- to 5-year-old children.
- The cubbies are a suitable height (48 inches) for children, which can prevent physiological injury.
Figure 5.10 Entry zone cross-sectional view
the teachers to store educational materials. The dimensions of all of the counters and cabinets are typical of those used in preschool classrooms. The dimensions are good for children to retrieve what they want such as various kinds of toys. As shown in Figure 5.11, the angle at which cabinets in the entry zone are placed provide an illusion of space. Cabinets placed at oblique angles minimize the perception of the space they take up within the entry zone (Sheffler, 2009), which is important, because they tend to occupy much of the space.

Figure 5.11  Cabinets used for storing children’s personal items and educational materials by teachers in the entry zone.
To the right of the cross-section view shown in Figure 5.10, there are four light switches on the wall, examples of switches used in the classroom. In a preschool classroom, sockets and switches should have a cover, irrespective of whether or not they are being used. Examples of these covers are shown in Figure 5.12. Furthermore, the switches and sockets should be installed at a distance greater than 50 inches from the ground, as small children can access anything placed at a height of 49 inches or lower. The sockets themselves have a safety device that prevents electric threats to children; the sockets have to have two or three poles simultaneously inserted for them to function. This means that if a child inserts something into one of the holes of the sockets, the sockets are designed not to function; hence there is no risk of electrical shock or injuries.

![Guards for sockets and light switches](image)

Figure 5.12 Guards for sockets and light switches

5.8.3 Quiet Zone

5.8.3.1 General

The identification of, analysis of and solutions for the quiet zone problems are summarized in Table 5.5. The redesign of the quiet zone is such that the left part is used as a manipulative and small block area and the right part houses wall storage, windows and short
tables (Figure 5.13). The recommended window height is 26 inches from the floor, which is low enough to let natural light into the room. The windows are designed to face to the east so that the morning sunshine can light the classroom and create a good setting for the children (Feinberg & Keller, 2010). As the classroom becomes brighter, children’s growth is enhanced. The low windows also allow children to look through the windows to be close to the nature.

In this quiet area of the room, a long counter with different dimensions than those in the other rooms is installed under the windows at a height of 26 inch. On the left side of this zone, two level, L-shaped seats with a seat width of 12½ inches are erected at a height of 11 inches. This size is very suitable for 3- to 5-year-old children as it is not a strain for them to use. The seats are made of a hard foam block for long hours of comfort. The right part also of the zone has a small bean-shaped table of about 700 square inches, 10 inches from the floor, with no chairs. The children can simply sit on the carpet and use the table without much difficulty, feeling free and relaxed, hence enhancing physiological development. It is important to note that all the tables in the classroom have the same surface area (as shown in Figure 5.14). The funny shape of the table makes children feel closer to a natural environment and protects them from accidental injuries from physical threats because the edges are flat and rounded throughout (Design Council, 2010); the tables are short enough for the height of the children height. A table that can be disassembled allows for more space and movement area for children’s activities. The identification of, analysis of and solutions for table problems are summarized in Table 5.6.
### Table 5.5 Quiet Zone Problems Identification, Analysis, and Solutions

<table>
<thead>
<tr>
<th>Problem: Quiet Zone</th>
<th>Mechanical Threat</th>
<th>Thermal Threat</th>
<th>Electrical Threat</th>
</tr>
</thead>
<tbody>
<tr>
<td>☒ Physiological Threat</td>
<td>☐ Chemical Threat</td>
<td>☐ Emotional Threat</td>
<td></td>
</tr>
<tr>
<td>☐ Organic Threat</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Analysis: Quiet Zone

**Electrical & Thermal Threats: Exposed electrical wires**

- Exposed electrical wires are dangerous for children. Pulling on a wire can cause an electrical fire. This is an electrical and thermal threat in the classroom.

**Physiological Threat: Lack of space**

- Because of less space, children cannot read, listen, write or take a break in the right posture. This is a physiological threat in the classroom.

#### Solution: Quiet Zone

**Solution Concept 1: Electrical and thermal problems**

- Exposed wires and computers should not be in a preschool classroom. The electrical items can generate thermal problems. Having no electrical products can prevent electrical and thermal injuries for children.
**Table 5.5 (continued)**

<table>
<thead>
<tr>
<th>Solution Concept 2: Physiological problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>• A low-density foam bench, which can provide reading seats for children, is necessary in a quiet zone. Each level of the bench is 11 inches high by 12 inches wide. This size is suitable for children, thus preventing a physiological threat.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Solution Concept 3: Emotional problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>• The bottom edge of the window is 26 inches from the floor to allow more sunlight to come into the classroom. Bright daylight can provide a joyful environment for children’s daily lives, which is good for their emotional development.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Solution Concept 4: Mechanical problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Half-door cabinets can make it easy to manage books by preventing books from falling down and hurting children.</td>
</tr>
<tr>
<td>• Half-door cabinets can help children find books easily, which can prevent the mechanical injuries that may occur during the process of finding books.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Solution Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Electrical items can cause thermal problems, even an electrical fire. The electrical products are unnecessary in a preschool classroom.</td>
</tr>
<tr>
<td>• A low-density foam bench provides a seat for children to read, listen and rest. The size is suitable and good for their physiological development.</td>
</tr>
<tr>
<td>• Low windows 26 inches from the floor allow more sunlight into classroom and also allow children to see outside easily. This can provide a good emotional environment for their study.</td>
</tr>
<tr>
<td>• Half door cabinets are good for children to find and manage books which can prevent mechanical injuries.</td>
</tr>
</tbody>
</table>
Figure 5.13 Quiet zone view.
### Table 5.6 Table Problems Identification, Analysis, and Solutions

<table>
<thead>
<tr>
<th>Problem: Tables</th>
</tr>
</thead>
<tbody>
<tr>
<td>☒ Mechanical Threat</td>
</tr>
<tr>
<td>☒ Physiological Threat</td>
</tr>
<tr>
<td>☐ Organic Threat</td>
</tr>
</tbody>
</table>

#### Analysis: Tables

**Mechanical Threat: Table corners**

- Sharp corners on a table may bring about blunt trauma, even deadly injury, if children run into the corner. This is a mechanical threat in classroom.

**Physiological Threat: Table size**

- The size of table is not suitable for children of this age. Unsuitable chairs and tables can bring about muscle strain, which is a physiological threat.

**Emotional Threat: Surface area and shape of table**

- There is not enough surface area at this table, which is shared by six children. A crowded space can cause irritable and distressed feelings in children, which is an emotional threat.
- A traditional table (such as a rectangular table) may not attract children; they may have an unfriendly mentality.
<table>
<thead>
<tr>
<th>Table 5.6 (continued)</th>
<th>Solution: Tables</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Solution Concept 1: Mechanical Problem</strong></td>
<td>![Image of smooth, rounded cornered table]</td>
</tr>
<tr>
<td>• Smooth, rounded-cornered table can reduce accidental injuries. A sharp-cornered table should not be in a preschool classroom.</td>
<td></td>
</tr>
<tr>
<td><strong>Solution Concept 2: Physiological Problem</strong></td>
<td>![Image of 20-inch height table]</td>
</tr>
<tr>
<td>• 20-inch height tables are used in the active zone. These are suitable for children of this age to use while they are writing and drawing, as they keep their arms and body in a state of relaxation.</td>
<td></td>
</tr>
<tr>
<td>• 10-inch high tables are used without chairs in the quiet and messy zones. Sitting on the carpet to use the table without much difficulty allows children to feel free and relaxed and enhances physiological development.</td>
<td></td>
</tr>
<tr>
<td><strong>Solution Concept 3: Emotional Problem</strong></td>
<td>![Image of funny shaped tables]</td>
</tr>
<tr>
<td>• The surface area of all tables is about 700 square inches, which is the minimum area for 2 to 4 children to share. They have enough private area to do their own work. Each child will not affect another, which can prevent emotional problems.</td>
<td></td>
</tr>
<tr>
<td>• Funny-shaped tables can enhance children’s enthusiasm. The table can be made into different shapes, which can attract children and promote good emotions. Two or more tables can be combined into different shapes which can improve the relationship among children’s friends.</td>
<td></td>
</tr>
</tbody>
</table>
Table 5.6 (continued)

<table>
<thead>
<tr>
<th>Solution Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Smooth and rounded corners help prevent mechanical injuries during playing.</td>
</tr>
<tr>
<td>• Suitable table height can provide good physiological development for the children.</td>
</tr>
<tr>
<td>• An adequate surface area (≥700 in²) for each table can allow 4 children to have private space, providing good emotional development.</td>
</tr>
<tr>
<td>• A funny-shaped table can attract children to learning and studying, and a different-shaped table combination can improve their relationships, which is good for their emotional development.</td>
</tr>
<tr>
<td>• The table is easy to disassemble and reassemble. If the table is not needed, it can be disassembled and moved to storage, which provides more space for children to do activities and move.</td>
</tr>
</tbody>
</table>
Figure 5.14 Different views of classroom tables
5.8.3.2 Safety

A cross-sectional view showing the windows in the quiet zone, messy zone, and part of the active zone is shown in Figure 5.15. There are two large windows, shown in areas 1 and 3, that have three functions. First, the windows are large enough to let a lot of sunshine into the classroom, but the light can be balanced so that the classroom can be bright for the children. Second, the windows let the children see outside as much as possible when they are in the classroom, allowing them to feel close to nature (Feinberg & Keller, 2010). Finally, the window sill can easily be used as a seat, as the height from the windowsill to the carpet platform is just 11 inches, which as Olds (2001, p. 243) affirmed, is the best seat height for 3- to 5-year-old children. Using soft cushions on the three sides of the window sill make the children feel comfortable. The identification of, analysis of and solutions for window problems are summarized in Table 5.7 and shown in Figure 5.16.

Figure 5.15  Messy and part of activity zone section view showing the window design
An important fact about this view is the design of windows: (1) and (3) are wide, low windows that allow children sit on their ledge; (2) and (4) are hopper windows, which are used for ventilation.
Table 5.7 Ventilation Problems Identification, Analysis, and Solutions

<table>
<thead>
<tr>
<th>Problem: Ventilated Windows</th>
</tr>
</thead>
<tbody>
<tr>
<td>☒ Mechanical Threat</td>
</tr>
<tr>
<td>☐ Thermal Threat</td>
</tr>
<tr>
<td>☐ Electrical Threat</td>
</tr>
<tr>
<td>☐ Physiological Threat</td>
</tr>
<tr>
<td>☐ Chemical Threat</td>
</tr>
<tr>
<td>☐ Emotional Threat</td>
</tr>
<tr>
<td>☒ Organic Threat</td>
</tr>
</tbody>
</table>

Analysis: Ventilating Windows

Organic Threat: No ventilation though windows

- These windows are inoperable, which doesn’t allow fresh air into the classroom. A closed and airless room can cause the spread of infectious diseases and breeding of bacteria, which is an organic threat for children.

Solution: Ventilating Windows

Solution Concept 1: Organic problem

- Operable windows allow fresh air and the full spectrum light into the room, and they also provide a home-like feeling for the children. They can prevent organic injuries for children.
- Ventilated windows types:
  - Double-hung and single-hung windows
  - Hopper window (opens in)
  - Awning window (opens out)
  - Casement window (opens out)
- Hopper and awning windows are the safest for children’s classrooms. The opening is limited to less than 6 inches, which prevents children from falling out.
- A hopper window is usually installed at the top of a wall, and it opens inward, which prevents the window from hitting children.
- Awning, double- or single-hung and casement windows should be installed at a height above the children’s head.
Table 5.7 (continued)

<table>
<thead>
<tr>
<th>Solution Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Hopper windows are installed at the top of the wall. These windows can be adjusted by teachers and assistants.</td>
</tr>
<tr>
<td>• The adjusting mechanism must be above children’s reachable height.</td>
</tr>
<tr>
<td>• A hopper window can let fresh air and sunlight into the classroom, which can prevent the organic problems.</td>
</tr>
</tbody>
</table>

BEFORE

Figure 5.16 Views of a hopper window area
At the top of the same wall, shown in areas 2 and 4 of Figure 5.15, there are rectangular-shaped awning windows. The hopper windows can be opened in, a good way of ensuring natural ventilation, although operating them should be reserved for adults (Olds, 2001, p. 200).
The window materials are very special, using adiabatic and photochromic glass. Adiabatic glass can isolate extreme temperatures such that, when the window is subject to direct hot sunlight for a long period time, the inside stays cool, or on the other hand, the glass can keep the inside warm when the weather is rather cold. This can prevent thermal injuries when children touch the windows. Due to the intensity of sunshine at different times of the day, the photochromic glass can change into different colors in order to resist dangerous ultraviolet rays and, as a result, control classroom sunshine and temperature intensity. Two or three panes of this glass can be used together to reduce or eliminate noise pollution. However, these two windows cannot be opened because, if open, children could easily fall out of the window.

5.8.4 Messy Zone

5.8.4.1 General

As mentioned earlier, at the top of the wall there is a rectangular-shaped awning window made of glass for ventilation, The green-framed windows included in the design, shown in Figure 5.17, serve as the best means for children to remain connected to the outside environment, allowing them to look through the window and visualize the green nature of the surroundings (Design and Construction Services, 2004). The coolness of the green framed windows also supports the peaceful nature of the children’s classrooms. The window seat at the bottom of the large, low windows is made of soft foam and covered with oilcloth or leather. It is designed to be comfortable for long periods of sitting. For safety, a railing is necessary around the windowsill. The identification of, analysis of and solutions for window problems are summarized in Table 5.8.
Table 5.8  Window Problems Identification, Analysis, and Solutions

<table>
<thead>
<tr>
<th>Problem: Windows</th>
<th>☒ Mechanical Threat</th>
<th>☒ Thermal Threat</th>
<th>☐ Electrical Threat</th>
<th>☒ Physiological Threat</th>
<th>☐ Chemical Threat</th>
<th>☒ Emotional Threat</th>
<th>☐ Organic Threat</th>
</tr>
</thead>
</table>

**Analysis: Windows**

**Thermal Threat: Extreme temperature**

- Regular glass will reach an extreme temperature after exposure to the sun for a long time.
- Height of bottom windows frame is less than 10 inches. Children can easily touch window, exposing them to thermal injury.

**Physiological Threat: Sunlight & high window**

- Sunlight is reflected by the smooth wall, which causes a glare problem.
- Glaring light can cause fatigue or eyestrain, which can cause headaches and other problems.
- Children raise themselves on tiptoe in order to see outside, which can lead to muscular tension, even muscle injury.
- Narrow and high windows hampered children to see wide natural environment, which is bad for their physiological development.

**Emotional Threat: Narrow window**

- Narrow, oblong window cannot let enough sunshine into classroom. Lack of sunshine threatens children’s emotional health.
- Bad lighting can cause eyestrain and fatigue, so children may have negative emotions in their daily lives.
- Height of bottom windows frame is too high to watch outside, so children cannot enjoy sunshine and being close to nature, which is bad for emotional development.
Table 5.8 (continued)

<table>
<thead>
<tr>
<th>Solution Concept 1: Thermal problem</th>
<th>![Thermal insulation glass illustration]</th>
</tr>
</thead>
</table>
| **Thermal insulation glass:**       | • Isolates the extreme temperature differences between outside and inside  
                                         • Avoids thermal injuries that may be caused when children touch the window |
| **Photochromic glass:**              | ![Photochromic glass illustration] |
| • Adjusts the intensity of sunshine coming in to balance interior lighting  
                                         • Avoids thermal injuries that may occur when children are exposed to excess sunlight. |

<table>
<thead>
<tr>
<th>Solution Concept 2: Physiological &amp; organic problem</th>
<th>![Window sill material illustration]</th>
</tr>
</thead>
</table>
| **Window sill material:**                           | • The internal material is a low-density, soft and comfortable foam, which provides a soft seat for children.  
                                         • The external material used to cover the foam is leather and oilcloth, which are natural and non-chemical.  
                                         • These materials are easy to clean, which can prevent organic threats. |

<table>
<thead>
<tr>
<th>Solution Concept 3: Emotional problem</th>
<th>![Emotional problem illustration]</th>
</tr>
</thead>
</table>
| • The wide and high window allows enough sunlight into the classroom, and the bright daylight arouses children’s enthusiasm and energy.  
                                         • The soft and comfortable windowsill provides a seating area for children, which can reduce a sense of anxiety. |
Table 5.8 (continued)

<table>
<thead>
<tr>
<th>Solution Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Thermal insulation glass can isolate the extreme external temperatures, which reduces the thermal injury by the window.</td>
</tr>
<tr>
<td>• Photochromic glass adjusts the intensity of sunshine by balancing the lighting, preventing children’s direct exposure to sunlight.</td>
</tr>
<tr>
<td>• Vacuum glass prevents noise transmission, which can affect children’s intelligence and other tissue growth.</td>
</tr>
<tr>
<td>• The 11” height of the windowsill makes it convenient and safe for children to sit and climb, preventing physiological injury.</td>
</tr>
<tr>
<td>• The combination of low-density soft foam and a leather cover provides a safe seat for children. The window sill seat allows children to be close to nature, which can reduce their feelings of uneasiness.</td>
</tr>
</tbody>
</table>

![Diagram]

BEFORE

![Before Image]

Figure 5.17 Views of green-framed window area.
AFTER

Figure 5.17  (continued)
The messy zone is used as the children’s lunch and snack area. The floor of this zone is made of vinyl flooring, making it obvious that children cannot sit on the floor. In the redesign, foam pillows are used during snack or lunchtime, after which they can be affixed to the wall. This is a safety measure that, besides ensuring that cleaning is convenient, means that children cannot easily stumble over them when having lunch or snacks, preventing the occurrence of mechanical injuries. The foam pillows are the same dimensions as the chair, 12 inches wide and 11 inches deep. They are made of different, gradually varied, light colors, as shown in Figure 5.18. Carpets and mats used on the floor are important in making sure that children are comfortable while engaging in their activities while also preventing slipping and falling (physical threats) (Tremblay et al. 1999). They can be easily removed while children are engaged in different activities and then cleaned and returned to the floor. The different light colors make children feel comfortable.

### 5.8.4.2 Safety

In the messy zone, there is limited movement because tables, chairs and cabinets take up most of the space. The messy zone is redesigned to facilitate feeding children (meals and snacks). The foam pillow is the same size as that of the chair (12” wide x 11” deep). The array of light colors makes children feel comfortable. When not in use, the foam pillow can be affixed to the wall in order to save space and reduce danger.

**Figure 5.18 Removable floor mats.**
snacks). The floor surface has a platform made of resilient vinyl flooring, carpet and linoleum. Where a carpet is used, woven carpet is usually the best choice. A light-colored and low-texture carpet can easily show where there is dirt that needs to be cleaned up, thus preventing bacterial growth. Moreover, the three materials are washable and do not easily gather dirt. However, a vinyl floor is most appropriate in the messy zone and is often composed of PVC (polyvinyl chloride), vinyl flooring or any type of fungus-resistance and damp-resistant wooden floor material. Like the other products, the materials are easily washable and come with other benefits: for example, they are fireproof, damp resistant and resistant to fungi. In short, these are the best floor materials to reduce organic and mechanical threats among the children, especially in damp environments or when children play with each other after meals in the messy zone. The identification of, analysis of and solutions for window problems are summarized in Table 5.9 and illustrated in Figure 5.19.

Table 5.9  Flooring Problems Identification, Analysis, and Solutions

<table>
<thead>
<tr>
<th>Problem: Flooring</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>☒ Mechanical Threat</td>
<td>☐ Thermal Threat</td>
<td>☐ Electrical Threat</td>
</tr>
<tr>
<td>☐ Physiological Threat</td>
<td>☐ Chemical Threat</td>
<td>☐ Emotional Threat</td>
</tr>
<tr>
<td>☒ Organic Threat</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Analysis: Flooring

**Mechanical Threat: Lack of carpeting**

- Not enough carpets are used in this classroom. Rugs and carpets can reduce the mechanical injuries for children.
Table 5.9  (continued)

<table>
<thead>
<tr>
<th>Mechanical Threat: Hard-fiber carpets</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Hard fiber carpets are used in this classroom. It is a high density carpet, which cannot reduce the mechanical injuries and may cause bruise.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Organic Threat: Carpet color</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Brown carpet is difficult to clean, as it can accumulate and hide dirt and bacteria. It brings an organic threat to the classroom.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Solution: Flooring</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Solution Concept 1: Mechanical problem</strong></td>
</tr>
<tr>
<td>• Carpet is essential in a preschool classroom. Acrylic carpet is soft, cozy and practical, which can reduce mechanical injuries.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Solution Concept 2: Mechanical problem</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• In the quiet and active zones, a 5-inch-high carpet platform provides safe flooring for the children. The internal material is low density polyethylene foam, which is neither completely solid nor completely soft. This foam can reduce mechanical threats from falling down.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Solution Concept 3: Organic problem</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Linoleum is used as an underlayment for the 5-inch-high carpet platform. Linoleum can be installed over any flat, dry and clean surface and is durable and easily cleaned. It can prevent organic problems.</td>
</tr>
<tr>
<td>• Acrylic carpet can also be used for the underlayment of the platform. It can resist moisture, mildew, crushing and stains.</td>
</tr>
</tbody>
</table>
Table 5.9 (continued)

<table>
<thead>
<tr>
<th>Solution Concept 4: Organic &amp; physiological problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>• For the messy zone and entry zone, vinyl planks are durable and easy to clean. This material is soft underfoot and comfortable to stand on for long periods of time. It also is warmer than other hard surfaces. This material can prevent organic and physiological problems.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Solution Concept 4: Organic problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Cork flooring is a natural thermal and acoustic insulator. It resists fire, stains, mold and mildew and is easy to clean, which can prevent organic injuries.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Solution Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>• The materials used for the 5 inch-high carpet platform are linoleum and low density polyethylene foam. These platforms are used in the quiet and active zones in order to prevent mechanical injuries and organic problems.</td>
</tr>
<tr>
<td>• Cork flooring and vinyl planks are used in messy zone and storage and observation areas. These materials can prevent organic and physiological problems.</td>
</tr>
<tr>
<td>• Dirt is observable on light carpet making it easier to clean, which prevents organic threats.</td>
</tr>
</tbody>
</table>
BEFORE

Figure 5.19  Design features that alleviate threats in the active zone and quiet zone
Figure 5.19 (continued). Showing different ceilings
5.8.5 Active Zone

5.8.5.1 General

The active zone is composed of four tables and 16 chairs; ordinarily, a table is shared by two to six children. The tables are small and low with a height of 20 inches, and the chairs are 11 inches high, 12–13 inches wide and 11 inches deep (Figure 5.20), the actual stipulated and standardized size for 3- to 5-year-old children (Olds, 2001, p. 343). Armchairs (chairs with armrests) are best for children to prevent mechanical threats such as falling (Design Council, 2010), so the chairs have armrests on both sides at a height of 5 to 6½ inches. In addition, the tables and chairs are versatile and can be used for a number of activities aside from eating. The identification of, analysis of and solutions for seating problems are summarized in Table 5.10.

Table 5.10  Seating Problems Identification, Analysis, and Solutions

<table>
<thead>
<tr>
<th>Problem: Seats</th>
</tr>
</thead>
<tbody>
<tr>
<td>☒ Mechanical Threat</td>
</tr>
<tr>
<td>☒ Physiological Threat</td>
</tr>
<tr>
<td>☐ Organic Threat</td>
</tr>
</tbody>
</table>

**Analysis: Seats**

**Mechanical Threat: No armrest**

- The capacity to balance is undeveloped for children of these ages. Without an armrest, chair may cause mechanical threats while children are sitting.
### Table 5.10 (continued)

<table>
<thead>
<tr>
<th>Physiological Threat: Chair material</th>
</tr>
</thead>
<tbody>
<tr>
<td>• The chair material is hard wood, which is bad for children’s bone development.</td>
</tr>
<tr>
<td>• Hardwood chairs are difficult to manage and arrange. During free time, the chairs were upside down on the table.</td>
</tr>
</tbody>
</table>

#### Solution: Seats

### Solution Concept 1: Mechanical problem

| • Both sides have an armrest at a height of 5–6.5 inches to prevent children from falling out of their chair. For children of these ages, the armrest is necessary to prevent mechanical injuries. |
| • The base of the chair (circled in red) is designed to prevent children from falling backward while they are sitting in the chair. |

### Solution Concept 2: Physiological problem

| • 11 inches high is the standard height for children in order to prevent physiological problems. For sitting, children’s feet can be on the floor and with their legs relaxed. A suitable size chair can provide healthy and safe physiological development. |

Source from: h220430 Studio (2014)
### Table 5.10 (continued)

<table>
<thead>
<tr>
<th>Solution Concept 3: Emotional problem</th>
<th><img src="image" alt="Colorful Foam Mat" /></th>
</tr>
</thead>
<tbody>
<tr>
<td>• A colorful and low density foam mat is used in the messy zone. It can help children distinguish between different areas in order to reduce their chaotic feeling.</td>
<td><img src="image" alt="Colorful Foam Mat" /></td>
</tr>
<tr>
<td>• Using a colorful mat for meals can allow children to have a good and exciting mood, which encourages children to finish their snack or meal.</td>
<td><img src="image" alt="Colorful Foam Mat" /></td>
</tr>
</tbody>
</table>

### Solution Summary

<table>
<thead>
<tr>
<th><img src="image" alt="Demountable Chair" /></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Both sides of 5-6.5 inches handrails prevent children falling down to get mechanical injuries.</td>
</tr>
<tr>
<td>• Demountable chair can save more space and movement areas for children, which can avoid mechanical threats during their activities.</td>
</tr>
<tr>
<td>• 11-in height chairs are suitable for 3-5 years old children in order to provide a good physiological seat.</td>
</tr>
<tr>
<td>• Colorful foam mats are used in messy zone, which can attract children’s attention in order to eliminate the negative emotional problems.</td>
</tr>
</tbody>
</table>
Before

![Before image of classroom](image1)

After

![After image of classroom](image2)

Figure 5.20 Back, front and side views of recommended chair design for children to be used in the active zone

This is a standard and safe chair and other shapes can be used for the seat surface; the most important aspect is safety for children.
5.8.5.2 Safety

Some safety elements included in the active zone and the adjacent observation area are shown in Figure 5.21. In the active zone, outlined in the blue box within Figure 5.21, is where some of the personal cabinets and cabinets holding educational materials are located. All the cabinets are the same size. The observation room windows are installed above the personal cabinets. These observation windows are made of one-way mirror glass. Once in the

Figure 5.21  Cross-sectional view of the active zone including the view from the observation room
Active zone is designated by the blue box.
observation room, one is able to see the children through the glass without the knowledge of the children. This observation mirror into the active zone also plays an additional function of enlarging the classroom (Burgstahler, 2008). Generally, a large and brightened active zone is good and helps to enhance the growth of children. Two light-colored tables, each 10 inches wide with an area of about 700 square inches, are placed in front of personal cabinets. These tables are also used as a painting, collage and clay area. To the left of the active zone is storage space.

5.8.6 Restroom

5.8.6.1 General

The identification of, analysis of and solutions for restroom problems are summarized in Table 5.11. The restroom (Figure 5.21, area 2; Figure 5.22), contains two toilets, two children’s hand-washing sinks, one adult sink, counters and cabinets. Normally, two toilets and two hand-washing sinks would serve a classroom of 20 children; in other words, the facilities should be in the ratio 1:10 (one toilet and one sink for every 10 children). The hand-washing sink is essential because young children tend to touch and hold everything, which means that their hands are at high risk of getting into contact with many forms of germs, and this increases the need for them to wash their hands frequently (Design Council, 2010). The hand-washing sink should be placed at a height of 22 inches because most children like playing with water, which means a specially designed wash table should be used. In Figure 5.21, the wash table is shown with the edges curved like a big bowl. If water splashes onto the table, it drains back into the sink because of the curved edges. As result, children cannot easily get into the water. In addition, the height of the restroom toilets is 11 inches, the same as the height of the chairs in the classroom, to increase the convenience for the children.
5.8.6.2 Safety

There is extra space in the restroom to allow teachers or caregivers to assist the children. For instance, the toilet measures 1 x 2 feet with a surrounding area of 3 by 4 feet. In addition, there is a 24-inch high partition between the two toilets that is good for children’s privacy and self-consciousness. Further, the toilet lids are made with a soft covering to avoid organic and mechanical injuries. The toilets have lids because, should a toilet be flushed without a lid, the cyclone effect from the flushing allows germs (microorganisms) to fly up to six yards in the air and remain in the air for many hours. The germs are dangerous for all people and can have severe effects among children, hence the necessity for toilet lids.

As with the floor in the entry, the floor material used in a restroom should have some texture to prevent children from falling down, thereby reducing mechanical injuries. The restroom floor in this classroom is made of skid-proof tiles, precisely vinyl-enhanced tile.

Table 5.11 Restroom Problems Identification, Analysis, and Solutions

<table>
<thead>
<tr>
<th>Problem: Restroom</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Mechanical Threat</td>
</tr>
<tr>
<td>☒ Physiological Threat</td>
</tr>
<tr>
<td>☒ Organic Threat</td>
</tr>
</tbody>
</table>

Analysis: Restroom

Organic Threat: No lids on garbage can and toilets

- Without lids on the garbage can, children are more likely to have contact with dirt and bacteria. Children’s unconscious behavior may cause organic injuries.
- When a toilet flushed without a lid, the cyclone effect of the flushing allows germs (microorganisms) to fly up to 6 meters away and can remain in the atmosphere for many hours. This is an organic threat for young children.
Table 5.11 (continued)

<table>
<thead>
<tr>
<th>Emotional Threat: Personal space</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Separation of two toilets is necessary. Children need their own private space. They do not want to be seen while using the toilet. No separation may cause an emotion threat for the children.</td>
<td><img src="image1" alt="Image" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Physiological Threat: Toilet size</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• An unsuitable toilet size may affect children’s physiological development. The height of toilet is greater than the standard limit, which may cause physiological injuries.</td>
<td><img src="image2" alt="Image" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Solution: Restroom</th>
<th></th>
</tr>
</thead>
</table>

**Solution Concept 1: Organic problem**

• Having a lid on the garbage bin can reduce the frequency of contact with dirt and bacteria and prevent organic threats.

• Soft toilet lids should cover the toilet, especially while flushing. The lid can prevent microorganisms and germs from getting into the atmosphere. This can prevent organic threats.

**Solution Concept 2: Emotional Problem**

• 24-in height partition should be used between two toilets. This partition can avoid embarrassing situation and mood for children, and also provide a private space. This can give a safety emotion environment for their growth.
Table 5.11 (continued)

<table>
<thead>
<tr>
<th>Solution Concept 3: Physiological problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 11-in (290mm) high toilets are a suitable size for children 3–5 years old. When children sit on toilet, their feet can be flat on the floor, preventing physiological threats.</td>
</tr>
<tr>
<td>• The surface of the toilet seat is 4 inches wide by 12 inches in length. This size can prevent children from falling into the toilet, preventing physiological threats.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Solution Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>• The lids of garbage cans and toilets are necessary in order to prevent the organic problems.</td>
</tr>
<tr>
<td>• A 24-inch high partition between toilets allows children to have their private space, which prevents emotional problems.</td>
</tr>
<tr>
<td>• The standard size of toilet is suitable for 3-to 5-year-old children, which can prevent physiological injuries.</td>
</tr>
<tr>
<td>• A disinfection cabinet, used to store and disinfect children’s toothbrushes, cups and tableware, is necessary for a preschool classroom in order to reduce organic injuries.</td>
</tr>
</tbody>
</table>
Figure 5.22  Restroom layout and facilities
5.8.7 Porch

5.8.7.1 General

The design of the classroom porch is shown in Figure 5.23. The identification of, analysis of and solutions for the porch are summarized in Table 5.12. The purpose of the porch is to act as a buffer between the outdoors and the indoors after children play outdoor activities. They can take off their shoes and outerwear there, which prevents dirt from being brought into the classroom, which in turn reduces the organic threat for children. The porch is near the restroom, which allows children to easily wash their hands after playing outdoors. The porch’s roof is designed as shutters with the colors of the different pieces designed to
follow the order of the colors in a rainbow. The rainbow design is meant to enhance the
children’s emotions. The angle of the rainbow shutters of the roof can be adjusted to balance
the amount of sunlight coming into the classroom and to prevent rain from coming into the
classroom. Thus, the porch prevents thermal, chemical and biological threats (Piotrowski &
Rogers, 2010). The space is designed to allow plenty of natural light to enter the classroom
for the relaxation of the children. The general goal of the porch classroom is to make sure
that children are safe and comfortable as they feel the natural environment during their
studies or games.

5.8.7.2 Safety

The porch is an effective area for releasing emotional stress and injury among
children, especially with the warm colors and the bright light present there. The roof design
is based on the principle of shutters. The strength and angle of sunshine are different during
different times of the day and different seasons in the year. The shutter roof angle can be
adjusted to balance the amount of sunshine coming into the classroom and also to prevent
rain from coming in. The porch offers a buffer area to prevent dirt and bacteria from being
brought directly into the classroom after outside activities. The porch is a connection between
the classroom and the yard. If any emergency, such as a fire hazard arises, children can exit
outside through the yard and far away from the dangerous area. Thus, the porch and this door
also can serve as an emergency exit for the classroom.
Table 5.12. Porch Problems Identification, Analysis, and Solutions

<table>
<thead>
<tr>
<th>Problem: Porch</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Mechanical Threat</td>
</tr>
<tr>
<td>☐ Physiological Threat</td>
</tr>
<tr>
<td>☒ Organic Threat</td>
</tr>
</tbody>
</table>

Analysis: Porch

Organic Threat: Poor environment

- Germs and microorganism will disseminate faster due to the poor porch environment, which can cause an organic threat for the children.

Emotional Threat: Poor lighting

- The design of porch’s roof does not allow enough sunlight to enter the classroom; the dim internal lighting can increase negative feelings for the children.

Solution: Porch

Solution Concept 1: Organic Problem

- ESD rubber is used to cover the concrete flooring. ESD rubber is durable and easily cleanable. This porch is a connection between the outside and inside. Children can clean themselves on the ESD rubber before coming back to classroom, which can prevent organic hazards.
Table 5.12 (continued)

<table>
<thead>
<tr>
<th>Solution Concept 2: Emotional problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>• The roof of the porch follows the shutter principle of design. Based on the sun’s attitude and intensity, the angle of the roof’s shutters can be adjusted to allow sunlight into the classroom.</td>
</tr>
<tr>
<td>• The colorful shutter roof looks like a rainbow. The polycarbonate roof can reflect different delicate-spectral light into the classroom to provide a sunny and healthy environment for the children.</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Solution Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>• The combination of ESD rubber and concrete provide a clean porch for the children, reducing organic hazards before children go back into the classroom.</td>
</tr>
<tr>
<td>• The angle of the roof’s shutters can be adjusted to allow enough sunlight into classroom. Bright lighting provides a sunny mood for children</td>
</tr>
<tr>
<td>• The rainbow roof provides a colorful and dream-like feeling for children, which allows them to grow in a good emotional environment.</td>
</tr>
</tbody>
</table>
Figure 5.23 Classroom porch attached to the classroom.
The roof is composed of various colorful shutters that can be adjusted to balance the level of sunshine and prevent rain from coming into the classroom.
5.9 Summary

The images shown in Figure 5.24 illustrate some of the design concepts used to reduce the various threats to children 3- to 5-years old in the classroom. It must be noted that, as much as there were some elements of the interior design that enhanced the safety of young children in the classrooms, there were other elements that reinforced some threats for the children. For the most part, the threats in both these classes included emotional, physiological, electronic and mechanical threats. These were influenced by hard surfaces, exposed computer wiring and lack of enough color and lighting in the classrooms. Although for the most part the two classrooms are almost similar with regard to the interior design elements that pose a risk to children, by some degree, classroom 0372 currently has fewer threats and risks compared to classroom 0378. However, threats that were less prevalent in both classes and the corridor were organic, chemical and thermal threats. In essence, therefore, based on the literature reviewed that led to the findings of this study’s analysis, it is imperative that the interior design of both classrooms and the corridor be improved in order to improve the safety of the children that use these classrooms.

Overall, the goal of the redesigned classroom was to make the children both safe and comfortable. While they study and play in this classroom, children need to feel that they are in a homey and natural environment. The three primary colors—red, yellow, and blue—were chosen to be used for this classroom. These colors are natural colors, and light colors can make a classroom feel warm, bigger and residential. Ulrich (1990) asserted that brighter, warm colors tend to appeal to younger children’s generally happy and imaginative moods. The redesigned classroom also contains many natural elements such as a “rainbow” roof and a “cloud” ceiling. These natural elements can induce children to have a pleasant mood and enhance their imaginative thinking and abilities.
Two different styles of ceilings are “cloud” ceiling and light green ceiling. The “cloud” ceiling embedded in the ceiling makes people perceive that the space is larger (Docherty et al., 2006). The height of ceiling is about 8–10 feet. Hanging lights can cause children to experience a panicky feeling; however, embedded “cloud” lighting avoids this problem, as illustrated in Figure 5.24. The choice of the ceiling’s material is plasterboard, which is light, adiabatic, sound absorbing and flame retardant, which can reduce thermal injuries in the classroom. In addition, when children see the cloud, they can imagine that they are in nature, and the resulting good mood can enhance their learning efficiency and is good for their development. The cost of a light green ceiling is cheaper than the cloud ceiling. In some developing countries, where cost is a bigger factor, the light green ceiling is a good choice for a preschool classroom, as it also can improve children’s moods, for instance, while they lie in the nap area to take a break. The green color can make this classroom become more natural feeling and not boring.

At the same time, the light in the classroom is warm and without glare. The warm colors and bright light provides the children with a good natural environment that can prevent emotional distress (Berris & Miller, 2011). Dimming circuits, which can adjust the strength of lighting based on the brightness needed, are used for classroom. None of the cabinets, counters, tables or chairs has pointed corners, as pliable and rounded corners are advised to help prevent mechanical threats. Furthermore, the paints used for the classrooms walls and ceiling are the water-based and zero VOC paints. This can reduce the threat of chemical injuries for the children in terms of the air that they breathe or if they touch the walls or get something from the wall into their mouths. Furthermore, hardly any electrical products can be found in the classroom except the lighting and air conditioning equipment. The computer,
radio and other electrical gadgets were moved to the storage room. Furthermore, the sockets and switches are covered by a lid. The ceiling also has an automatic sprinkler system and fire alarm system to help prevent thermal threat injuries. Therefore, this classroom is a safe, comfortable and natural study environment for preschool children.

In the classroom, reducing fire hazards is necessary and required. The fire prevention designs of a facility should follow the National Fire Protection Association Codes. Fire sprinklers, smoke and fire alarms, and fire extinguishers are essential items in classroom. The approximate weight of each fire extinguisher is 40 pounds, and each can cover a distance of 30 to 50 feet. In the about 1,000 square foot classroom, two or more extinguishers are necessary, and they should be placed where children cannot reach them. Fire sprinklers and alarms should be installed in each zone area to reduce the thermal threat for children.
Figure 5.24 Overview of the redesigned classroom
Figure 5.24 (continued). Interior view
Figure 5.24 (continued). Interior view
Figure 5.24 (continued). Interior view
Figure 5.24 (continued). Top view
Figure 5.24 (continued). Top view
Figure 5.24 (continued). Top view
CHAPTER 6. REFLECTION AND CONCLUSIONS

In summary, this study has focused on factors that pose potential threats of injury and illness to young children in preschool classrooms. Although, the safety and wellbeing of users of interior spaces are always the designer’s top priority, in practice, it is not always easy to explain how this responsibility can best be undertaken, or even, how best to explain it. Such an explanation has been the focus of the study. This section provides a short summary of the Palmer case study. That portion of the project emphasizes the necessity of designers considering a wide range of issues when attempting to safeguard users of interior spaces, especially in ensuring the health and safety of children in preschool. But, it also underscores the value of designers and researchers paying detailed attention to safety issues in children’s environments of all types.

While the case study provides some answers to the project’s primary research questions, it has also attempted to provide equally valuable general guidance concerning methods of applying and communicating health and safety research to projects of all types. By discussing the theory of threat-based definition of health and safety, it illustrates the value of defining and analyzing health and safety in terms of individual sub-problems and the individual issues they pose. It also shows the value of communicating design solutions in terms of this same building block approach.

Overall, the project addressed four key design issues: 1) what are the major threats to children 3-5 years of age in preschool classrooms, 2) how do such threats affect children’s learning in schools, 2) what are the necessary safety measures needed in preschool classrooms to control or eliminate the threats, and 4) what are some of the policy measures needed to ensure overall classroom safety in their classroom?
Primarily data in this research is secondary data, drawn from research reports, code and regulatory requirements and other scholarship in the field. The feedback and response of teachers and guardian also provided insight for the classroom design. During the redesign of the existing classroom, safety and health were given top priority. It was established that seven main types of threats affect children interiors with various causes, which are mechanical, electrical, chemical, organic, physiological, thermal and emotional threats. However, not all threats appeared in equal measure—if at all—in American preschool classrooms. From this case study, there was evidence to suggest that in Unite States’ preschool classrooms; mechanical, organic, chemical and thermal threats pose a disproportionate threat to their users.

The literature suggested that mechanical threats were found to be common, and that would appear to be supported by experience in this case study. Poor arrangement of furniture, use of slick floors, and a variety of base-supported pieces of equipment pose constant threats of falling. Designers cannot always eliminate this threat, but careful attention to the issue can reduce their frequency and severity. For example, soft flooring materials can relief injury by falling down such as carpets or platform. Round and smooth corners of all furniture can reduce crush injury even some fatal harm.

Chemical threats in classrooms come from several sources. Inadequate pre-installation removal of asbestos, lead-based paints and other similar substances pose potential chemical threats in many remodeling projects. For classroom painting and finish, zero volatile organic compounds (Zero VOC) and natural water-based paints make significant contributions to healthy classrooms.
Biological (also called organic) threats caused by poor attention to such factors as moisture leakage, dampness, difficult to clean surfaces, contribute to the presence and growth of viral and biotic materials. The proper specification, installation and maintenance heating, air conditioning and other climate control systems ensure thermal comfort in preschools and protection from adverse thermal conditions. Windows and other provisions for ventilation are also important. Windows can balance the internal lighting intensity, which allow natural and fresh air recycles in classroom.

While mechanical, organic, chemical and thermal threats appear to be most common in the U.S., other threats cannot be ignored. The consequences of exposure to electrical threats can be severe. Thus, the installation of sockets, switches, and electrical wire must comply with the electrical installation code. To avoid physiological threats, suitable size of furniture and items are important for children. Emotional threat is a complex problem, which usually can be affected by other six threats. As exhibited in the case study, the visual characteristics of furnishings, materials and assemblies used to control other threats, can also make strong contributions to the emotional wellbeing of students.

The thesis did face a number of limitations. First, having relied on secondary data, the study may not have identified all issues that have been previously noted by staff, students and parents. It is reasonable to expect that some safety issues may have been among those factors that were not identified. Secondly, the design may have fallen short in some respects due to the decision to base the case study on an existing space, with all its shortcomings.

The entry zone is the transition area for classroom. Space and seating for parent waiting, observation, sign-up, and interpersonal communication would be ideal in this location. However, the long, narrow proportions of the existing space and heavy traffic
posed some limitations in this regard. Sleeping and napping bed can provide a rest area for children after lunchtime or when they are tired. But, again, these activities were limited by the absence of opportunities for introducing spatial separation (Olds, 2001).

In general, other efforts to redesign the Palmer space might have dealt differently with certain of the provisions that were included here. For example, the manipulative area and math area could be designed in a quieter zone if the space were available. The messy zone could benefit from easily cleaned flooring materials; therefore, water play area, sand and clay area, painting area, collage area, and woodworking area would be possible in this area. In the active zone, the main activity area for children’s daily lives, provision could be made for large-block play, dramatic play, and large motor activity. The restroom location should be closed to messy zone and active zone, which to encourage children to form positive hand washing habits. Were more space available, large group meeting area and private/semiprivate should be available in preschool classrooms. Large group meeting areas can provide space for children to study and play activities, allowing them to enjoy those facets of learning. Children at this age need private space where can store their items and defuse their negative emotions (Olds, 2001).

This study focuses on the United State preschool classroom threats. As a developed country, the U.S. is able to devote more attention to child safety issues than may have been undertaken in some other, less developed countries. However, one much needed area of interior design research is the exploration of methods by which developing countries might better address childhood health and safety within their economic constraints. Another important area for future research would be an examination of the extent to which threats to
health and safety not only impact the physical and emotional well-being of students but also jeopardize their intellectual growth and maturation.

In conclusion, health, safety and well-being are a fundamental responsibility of interior designers. And, nowhere is this more important than in the planning of educational environments for very young children. This is no simple undertaking. The management of health and safety issues is a highly technical and specialized facet of design. Development of professional knowledge, insight, experience and judgment in this aspect of the field is worthy of the designer’s priority attention.
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APPENDIX

Images of the existing project site
(letter/number designations refer to points identified in Figure 5.3)

A1: Organic Threats (Main Entrance for Palmer Building)

- In United States, more than 47% of American cities fall victim of poor air (WHO, 2010). Pictured is the only way to enter the Palmer Building. The outside flowerpot and trash can are dangerous for the young children as both provide an easy to accumulate dirt and bacteria. Children usually want to touch everything, so this is an organic threat for them.

A2: Mechanical Threats (Corridor)

- In the corridor, the floor is too smooth and could lead to people, including adults, falling down. Smooth surfaces tend to reflect light and those that are rough absorb light. The excess reflected light may result in a loss of surface definition, which can also potentially result in slipping and falling. The corridor has a little bit of a slope, so when the children run or walk fast, they may easily fall down.
A3: Mechanical Threats (Front Door Area for Room 0378)

- On the side of the corridor, the wood bench and chairs are used for the parents to rest and sit. However, the corners of the chair are dangerous for the children. For 3- to 5-year-old children, who love running and walking fast, the mechanical threat can affect the safety of the children. Mechanical injuries can be described as unintentional contact with objects or surfaces in the environment that result in either blunt pain, scrapes, piercing abrasions or other bodily impairment.
- Striking an element, such as a protruding door handle, the edge of window, or the edge of a classroom door, among others, will result in injuries for the children. The height of the door handle is about 30 inches and can lead to children’s hand injuries; this is a mechanical threat. The display board is an unstable object. While children play carelessly, it is easy for them to fall down and get injured. This is another kind of mechanical threat.

A4: Mechanical Threats (Entry Zone in Room 0378)

- The objects should be put inside the shelves, counter and cabinet to make sure they do not in any way fall on the children. In the classroom, the objects and boxes cannot be put into the shelves. While children play at activities, it is easy for them get mechanical injuries. The cabinets do not have a door to protect the objects, and there are many hooks inside. Children also can easily get hurt when they go to retrieve something.
A5, A12, A13: Electrical & Chemical/Radiological Threats (messy zone in room 0378)

- In a preschool classroom, exposed wires are dangerous for children. The children may pull on a wire and cause an electrical fire. Electrical injuries can affect children for a long time, even a lifetime.
- There is about 78% of kindergarten use of the computers in the classroom. Pupils in the classrooms are commonly exposed to chemical and radiological threats due to handling of electronic products such as the computer. So using the computer in classroom exposes children to chemical and radiological threats
- In A13, the socket is installed too low. Children are curious to do anything. Children can easily touch the socket or plug something into it, which can be deadly dangerous for them. This behavior is dangerous, and this is an electrical threat for children.

A6, A8, A10, A11: Mechanical Threats (active zone in room 0378)

- In a preschool classroom, the flooring material should be carpet because carpet is soft and comfortable. If children fall down, it also can reduce some injuries. In the active zone, the flooring is tile. In this area, there is a lot of furniture, such as chairs, tables and counters. In fact, the children have just a little space free for the activities area in this classroom. The small space can easily cause collision and mechanical injuries.
A7: Organic Threats (counters in active zone of room 0378)

- These drinking cups and toothbrush are exposed to the air. When children use them, they bring organic threats to the children.

A9, A14: Emotional Threats (lighting of room 0378)

- Natural light is very important for a room. The amount of natural light as noted in A9 and A14 is not enough to extend into the entire classroom. Thus, a lack of effective focus and attention on these elements lowers the child’s emotional safety as lack of these elements heightens environmental stressors increasing anxiety in the child, affecting children’s emotion development.

A15: Organic Threats (sink and washroom table in Room 0378)

- Using wood for the washroom table is not a good choice. The wood table can be decayed by water. Bacteria breed there easily, and when children touch them, it will cause the organic injuries for children.
A16, A17, A18: Organic & Mechanical Threats (restroom in room 0378)

- In A16, the edge of door is rusty; the rust is hazardous substance for human and an organic threat for the children.
- In A17, the shelf is too narrow and cannot accommodate everything on it. If something falls, it can cause a serious injury. This design is very dangerous and a serious mechanical threat.
- In A17, the other problem is the toilet, which should have a lid. When the toilet is flushed without a lid, germs or microorganisms can go up into the air about six yards high be transferred into the classrooms. These germs and microorganism can exist in the atmosphere for several hours and thus are dangerous for preschool children (and adults). This is an organic threat in classroom.
- In A18, the open low-level trash cans make it possible for children to throw through their trash without trying to open a lid, which may cause mechanical and physiological injuries, if the lid bangs on their hands.

B1, B5, B8: Electrical Threats (entry zone of room 0372)

- The sockets and switches can be easily reached by children. These dangerous electrical items should be installed higher where children cannot touch them. Also, the socket and switch need a cover to shield them when they are not being used. They are electrical threats for the children.
B2, B3, B9: Mechanical Threats (entry zone and active zone in room 0372)

- This classroom has the same problem as room 0378 (A4). None of counters and cabinets has covers. Children at the age of three are capable of moving; they want to climb on objects and use objects to move among others. During their climbing, some items may fall down. It is a mechanical threat for children.

B4, B5, B10: Mechanical Threats (active zone in room 0372)

- A ramp, slope and stairs should not be in preschool classroom. Because children of this age have just learned to walk, the ramp and stairs can make them easily fall down, causing mechanical injuries.
There is about 78% of kindergarten use of the computers in the classroom. However, the exposed computer wires are dangerous and should put in a safe place. If children pull and play the wire, it may cause electrical injuries. In B8, although the wire is covered, it is too obvious, and children may try to touch and open the casing because of their curiosity.

In this classroom are found several electrical appliances, such as a computer, router and CD player. During the use of these electrical appliances, they will produce some radiation, which is not good for children’s growth. This is a chemical/radiological threat for preschool children.
B12, B13, B14: Mechanical Threats (active room in room 0372)

- This area is the active zone, where children stay here play and learn most of time. The material flooring chosen should be bright carpets. For this brown carpet, if some dirt stays on it, it is difficult to find. For preschool classroom flooring, a carpet can reduce mechanical injuries when children fall down.

B15, B16: Organic and Electrical Threats (sink and washroom table in room 0372)

- In B15 is the same problem as in room 0378 (A15). The washroom table is made of wood, which is not a good choice of materials. The wood table can be decayed by water. Bacteria breed there easily, and when children touch them, it can cause the organic injuries for children.
- The other organic problem is the trash bin. Every trash bin should have a lid, and it needs to be fixed to one place.
- The blue cart is used as a water play area. However, an electric socket is installed near the washroom table. Water is an electric conductor, if children play with water near the socket, it can be deadly dangerous. This is an electrical threat.
B17, B18: Organic and Mechanical Threats (restroom in room 0372)

- The problems here are the same as in room 0378: lack of covers on the toilets and trash bin.
- A partition should be inserted between the two toilets to give the children privacy, while they are using the toilet, reducing any emotional threat.
- Some items are hanging on the wall. This is a risky design, as children could get injured if these items fall down. This is a mechanical threat for children.