

Does size matter?—Considering the importance of size and scale in educational environments

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ABSTRACT:

When creating environments for children, adults inevitably face the question of scale. What are the needs of the users? How high or wide should rooms be to instill a feeling of security and a sense of being sheltered by their small users? Does the provision of spaces suitable for children call for miniature environments or does the possibility to experience and explore spaces and furnishings at a variety of scales offer an important learning opportunity for children? How can the potential of educational buildings to function as a three-dimensional textbook and as a teaching and learning tool be fully embraced (Taylor, 2009)?

Architecture acts on our senses in many different ways: We do not only see the space, we feel it with all of our senses. We hear the different resonances or echoes depending on the size of the space and the materials used to build and finish it. We understand the distinctive tectonic properties of materials, their size and functions. These are important experiences for children who explore their world. Perception is an active procedure involving all of our senses, while the brain simultaneously processes numerous pieces of information (Guski, 2000). All this creates an overall understanding of the situation in time and space and trains the child's skills. Especially at a young age vestibular, kinesthetic, and somatovisceral senses mature (Walden, 2009). In an ideal world, every school and kindergarten would provide a balanced level of stimulation while reducing stress factors and disturbances to a minimum and allowing the users to physically use, explore and appropriate their learning environment.

This study will introduce several examples of schools and kindergartens where the architecture successfully adds to the curriculum in a way that the space helps to develop all human senses in the children and their perception of scale in the environments they are using.

CONFERENCE THEME: On Measurement

KEYWORDS: Scale, perception of space, educational environment, children, learning opportunity

INTRODUCTION

Recent debates about education—in the US as much as in other developed countries—have tended to analyze failing academic performance through a socio-economic evaluation of students' lives. However, the physical setting in which students are placed can also play a vital role in the overall success of the educational mission. When creating environments for children, adults inevitably face the question of size and scale. Is a smaller school to be preferred over a large one? What implications have the size of the administrative unit on the building itself and does this have an influence on how students perceive and connect with their schools? Does the provision of spaces suitable for children call for miniature environments—or does the possibility to experience and explore spaces and furnishings at a variety of scales offer an important learning opportunity for children? How high or wide should rooms be to instill in their small users a feeling of security and shelter? The question of size and scale in educational facilities has to be considered on a variety of social, psychological and physical levels. We need to recognize that a child's sensual perception is usually much more subtle and alert than commonly perceived and architects, designers as much as decision makers and parents have to be aware that "early perceptions imprints influence later perception habits." (Petermann, Menzel, 1997, p. 61). Childhood experiences of place and space are essential to the child's cognitive and social growth and their (independent) exploration is closely linked to the development of both self-concept and identity (Spencer, Blades, 2006).

I. HOW CHILDREN PERCEIVE THE WORLD

I.1. THE STAGES OF CHILD DEVELOPMENT

Piaget and others have clearly demonstrated that a child's development is directly linked to its ability to interact with its environment. Children develop an understanding of themselves through their interactions with events and materials outside themselves (Piaget, 1951). All educational environments have the ability to contribute or retard this process. Olds states "the motivation to interact with the environment exists in all children as an intrinsic property of life, but the quality of the interactions is dependent upon the possibilities for engagement that the environment provides" (Olds, 1979, p.91). Thus the school, as the "workplace" for children during significant stages of their development, is of tremendous importance.

Piaget distinguishes four different stages of childhood development that are pertinent to an analysis of educational space (Piaget, 1951; Singer and Revenson, 1978):

In the first months the child perceives and understands the world exclusively through perception. Sensual experiences and reflexes stimulate the development of gross motor skills as the child learns to roll over, sit up, crawl, stand, walk, run and eventually climb. Simultaneously the fine motor skills progress with increasing locomotion and allow small children to use their hands or grasp small objects with growing precision while they start exploring their surroundings. The interaction with the built environment is immediate, though the concept of space is not fully developed.

Between the ages of 2 and 7 children practice their motor skills through various forms of play. With the acquisition of language a new developmental stage begins and the importance of social interaction grows. This phase is characterized by curiosity but also by an egocentric perception of the world. At this age the child knows the world around it only through its own limited experiences and attempts to explain everything by own vantage point. At the same time this age group becomes more independent and usually has the urge to explore independently. The understanding of the world grows and the concept of space continues to develop. Slowly but steadily the child learns about space and spatial concepts.

In the concrete operational stage children begin to reason logically but are still rather concrete in their thinking. Slowly they discover the difference between perceived and relative scale and space. Between the ages of 7 and 12 a child can have conversations and think logically but still needs practical aids to develop its reasoning. This is the time when most children go to school on a daily basis. Social engagement with peers is intense and children continue to develop their motor skills. To do this, they often undertake tasks that may be described as daring and adventurous--the child continuously pushes its skills and limits. Successful mastery at these tasks helps to build self-esteem and overcome fear, and encourages the child to continue to grow. An environment that stimulates and offers a wide variety of spatial situations and experiences can be especially beneficial in this stage. However, at this time child sizes and development also vary greatly, especially due to age and sex. This demands special consideration by designers, as we have to be aware that the same solution will not be adequate for all users.

When entering the age of adolescence, the child enters the fourth stage. Between the ages of 12 and 16, the child passes the stage of formal operations and gains the ability to understand more abstract concepts. It is able to use formal operational thought, which enables it to think about the future, the abstract, and the hypothetical while clearly living in the present. The new abilities allow the adolescent child to think more flexible, solve problems through deductive reasoning, abstract thinking and systematic problem solving. Simultaneously the horizon of the child expands and the urge to explore beyond the known boundaries affect further development and social interactions. Peer acceptance and socializing with friends becomes continuously more important. An adolescent youth wants to be considered a grown-up and equal to adults. This should also be considered for their appropriate learning environment.

1.2. THE PERCEPTION OF SPACE WITH ALL SENSES

Architecture acts on our senses in many different ways: we do not only see the space, we feel it with all of our senses. We hear the different resonances or echoes depending on the size of the space and the materials used to build and finish it. We understand the distinctive tectonic properties of materials, their size and functions. These are critically important experiences for children who explore their world more intensely while they gradually develop a more holistic concept of space. Perception is an active procedure involving all of our senses, while the brain simultaneously processes numerous pieces of information (Guski, 2000).

Bishop describes the importance of the sensory quality of the environment and identifies key factors architects and designer should acknowledge:

The textures, the colors, the smells, the sounds in the space, and the lighting qualities are all features to be considered as tools to be arranged in a variety of combinations to create a sensory-stimulating environment. A sensory environment is one that (1) acts with and nourished all the users' senses deliberately, (2) has sensory qualities and sensory signposts used as part of all the chief functions of a play environment and the creator has consciously and consistently supplied sensory information in this way, and (3) has made the most of its natural advantages of location and then continued to add sensory detail, conscious of what these features are adding to the overall experience within the environment. (Bishop, 2004, p. 234).

Our five senses provide us with important information on our environment. While we are usually aware that we see space, touching, smelling, hearing and sometimes even tasting a space also provides us with particular pieces of information on our environment. Many of these pieces of information are processed unconsciously.

The human brain has the ability to select and organize this information into stable, recognizable images of places, which we interpret in terms of our shared cultural experience. Equipped with concepts and categories, we fit our raw sensory experience, like pieces of a puzzle into a meaningful whole. (Farbstein and Kantrowitz, 1978, p.8)

The sensory perception of space is also connected to the sense of equilibrium (vestibular sense), of movement (kinesthetic sense) and the somatovisceral senses that control bodily functions. All of them are "significantly involved in the perception of architecture" (Walden, 2009). They influence how we perceive a building and how we feel when we use it.

Adults usually have substantial experience in sensing their surrounding. Understanding and navigating even unknown environments has become a second nature to them. Children are still in the process of acquiring these skills. At the same time their perception is more alert and they are more sensitive to sensory impulses (Guski, 2000; Walden, 2009). They are building up their own repertoire of experiences in order to advance their overall understanding of the world in space and time. Thus the kind of direct interaction the spaces used and experienced by children afford have a critical role (Bell, 2006). Offering a variety of experiences and spaces in a range of perceptual and relative sizes and scales helps children to develop a multitude of cognitive and sensory skills. For that reason, spaces we experience in our childhood are of special importance and can influence spatial preferences as well as decision-making processes.

1.2.1. Tactility and vision

Humans decode space predominantly through a combination of tactility and peripheral vision. Vision dominates the other senses in the Western world and often is the sense we rely on most. Light reflects from surfaces and gives us information on shape and scale, colors, materials and textures, other people who might be using the space and activities that are going on. We visually evaluate distances or heights as well as other perceptual and relative spatial qualities. A child gradually learns the concepts of space and understands that what it sees is one piece of information that is complemented through perceptions of the other senses. At the same time we have to remember that decisions on the dimensions of space, furniture or equipment should be based on the scale of children and their anthropometric data. The average height of children, the reach of their arms and length of their paces as well as the angle of vision differs significantly from those of adults (Walden, 2009).

Construction materials and surfaces for school buildings should be carefully selected for the intended use. They are exposed to a lot of wear and thus it is vital that they age well, demand little or no maintenance and can be replaced easily if necessary. As schools are usually built on a tight budget, any unnecessary cost has to be avoided; nevertheless attention must be paid to good quality and durability as well as to their sensory and conceptual qualities. Certain building materials like brick or timber reveal some of their structural “duties” and can help the children understand how a building works, as they might be familiar with their general concept of these materials from building block towers or stick figures. Materials can support the potential of educational buildings to function as a three-dimensional textbook and as a teaching and learning tool (Taylor, 2009). At the same time a child can more easily relate to materials they know from their home environment. They can have the air of familiarity while at the same time introducing a sense of scale and texture.

Surface qualities of materials and their textures give important clues to the user about how to use certain spaces, areas or furnishings. They usually complement the visual impressions.

The textures, colors and forms applied to all the surfaces of the environment are the close-at-hand qualities of the environment with which occupants come most in contact, and what they “read” continually in experiencing a setting” (Olds, 1989, p.10).

The material choice in the true sense of the word is tangible with partially interesting tactile qualities. A soft carpet might invite children to sit, lie or play on the floor while a hard, cold stone floor in an adjacent area indicates that it would be used for circulation space (Denton and Smith, 2010). Soft materials and padding, especially on furniture, create a welcoming atmosphere and invite children to use them in a very direct way. These can also provide the needed spaces of shelter when a child needs to retreat for a while from the group.

The color of materials or finishes dominates the general impression of the school in many cases. Contrasting materials as well as color accents can spice them up. Painted surfaces can complement the material appearance or may be used as accents with strong colors for a few details only. An architectural language that is rather reserved and displays a clear and low-key appearance is characteristic to many well-designed schoolhouses. Limiting the design to only a few major materials, chosen for their properties, give the schools a distinct character while providing spatial clarity. While some researchers claim that carefully chose color schemes can influence student behavior, attitude and learning concentration (Sinofsky, Knirck, 1981; Gimbel 1997) no quantitative data has been published to verify this (Martin, 2006). Walls in the schoolhouses should be painted in neutral or muted tones. There is no need to artificially “sweeten” the architecture with cute details and “child-favored” colors. It is more important to provide a calm backdrop that allows the users to appropriate their environment with their own art and to avoid the danger of overstimulation and business. Once the children have conquered their space there will be plenty of color and play.

1.2.1 Acoustics

Sound is another important factor of how we experience a space. All environments--especially spaces in large institutions--are filled with sound. While this adds richness and supports the perception of a socially active space, sound can create distraction and discomfort. Sound intensity, localization and orientation also help us understand spaces (Gibson, 1966). The child needs training in order to learn how to identify the source of sound waves that reach its ear and also to distinguish meaningful from accidental sounds. The student needs to learn how to identify e.g. the voice of the teacher and listen to him while ignoring background noises. While adults can often deduce words they miss in a sentence, children have only limited capabilities to do this due to their limited vocabulary. A classroom with bad acoustics may have an enormous influence on the students' learning performance (Ledford, 1981; Crandell and Smaldino, 2000; Martin 2006). Not being able to understand the explanations of the teacher or what classmates are saying is not only a fundamentally frustrating experience but deprives the child from absorbing important information. The noise level of a space needs to be adequate to its intended use and has to be designed appropriately. Sound reflection and reverberation have to be carefully studied in classrooms as well as in common areas and designed to support the intended use. The proper choice of surface materials can go a long way--which again ties into the tactile considerations previously discussed.

However, muting the school environment too much and creating acoustically dead spaces can also be a detriment. Especially young children or those with disabilities usually enjoy experimenting with creating sounds. The observation of the echo of a sound the child has produced--the audible response and grasping the concept of cause and effect is an activity that can be easily implemented and is rewarding to the child. It is part of exploring the world. Activities involving sound can trigger the interest of children. Experimentation can be encouraged "when the sound responses are more musical or have a greater range of tones than when a single noise or note is issued repeatedly from the activity." (Denton and Smith, 2010)

1.3.A BALANCE BETWEEN STIMULATION AND SPACE FOR CONCENTRATION

A child's environment should provide "peaceful, but invigorated balance" with "sameness, predictability and contrast, stimulus" (Day, 2007). Offering a safe and reassuring base while providing stimulating challenges and possibilities is essential. Educational surroundings can play a key role in the cognitive, physical, emotional and social growth of the student and the influence of different spaces on the children has to be considered in order to provide an optimal learning environment. All this creates an overall understanding of the situation in time and space and hones the child's skills, especially at a young age when vestibular, kinesthetic, and somatovisceral senses mature (Walden, 2009). In an ideal world, every school and kindergarten would provide a balanced level of stimulation while keeping stress factors and disturbances to a minimum. This would allow the children to physically use, explore and appropriate their learning environment. A building for children should exhibit "difference within sameness" because "children are attracted to environments that promise mystery and new information in a safe and predictable setting" (Stewart-Pollack and Menconi, 2005). Grounded on this basic understanding we will now take a closer look at the school--as an institution and as a building with architectural features.

2. CREATING A VARIETY OF SPACES

2.1.A SENSE OF SECURITY

In order to provide a positive learning outcome it is important that the schoolhouse should be a place that instills a sense of security in the children. While it is difficult to isolate, quantify and measure the impact of the physical space on learning outcomes and performance it has been recognized that educational spaces are of high importance (Clark, 2002; Dick, 2002; Martin, 2006). Maslow states a series of basic needs that mark the stages of human development and growth. This "Hierarchy of Basic Needs" is also applicable to children and has a strong influence on the healthy physical and intellectual development of any human being. But how does architecture address these?

The built environment mostly caters to the first level (physiological needs) and the second level (the need for safety): providing shelter and a secure and stable environment. Architecture can also provide spaces that support social interaction and give the children a sense of belonging and a place to be with friends. Only once all the other needs have been sufficiently satisfied will a child start building self-esteem and pursue self-actualization or independent growth.

The Dutch architect Herman Hertzberger, renowned for the superb quality of his school buildings, requests that a school should have a residential atmosphere and appearance rather than an institutional one. He stresses the importance of the learning environment to have a familiar scale, to be "constant and readily identifiable" (Hertzberger 2008). At the same time, school prepares the child for a life in the world and has to instill curiosity and courage to venture beyond the known boundaries. The importance of providing social spaces that foster interaction is important.

A school with spaces on different scales offers children the possibility of simultaneously gathering different spatial experiences and of experiencing themselves within the constructed environment (Bell, 2006). All senses are addressed here: The echo of one's own voice or the reverberation of footsteps in an empty, big hall is a different acoustic experience than the reverberation in a small, sound-insulated room. Crossing a bridge between two buildings can convey a sensation of height; narrow walks or low rooms have different effect than wide and high ones. Tactile experiences of

different surfaces, too, or the different smells of the materials used can be definitive and beneficial for wellbeing inside the rooms. Used in a targeted or tightly controlled manner, spatial divergence and change will contribute to a stimulating learning and working environment.

Despite offering a variety of different spatial situations, schools should be clearly organized and open (Martin, 2006). The general effect of the architecture on its users is closely connected to the final design of the individual rooms and their degree of detail. The variety of high and low, protecting and spacious room sequences within every school should be experienced as pleasant but not unsteady or busy. A good school provides an atmosphere that is at once sheltering and simultaneously open by its spatial generosity. As the needs of children change with their age and maturity, so do their spatial needs. For learning environments that are used mainly for primary level teaching a good solution is a rather warm and protecting atmosphere, reminiscent to some degree of the familiar home. School buildings for older occupants, on the other hand, should have a more solemn, neutral air and offer the students a learning environment that is similar to adult workplaces.

2.2. DOES SIZE MATTER? – THE SCHOOL AS ADMINISTRATIVE UNIT

In the U.S. and in many other countries the trend throughout the second half of the 20th Century was to create large schools. This affected the educational unit as much as the educational building. Schools grew bigger while the number of elementary and secondary schools declined by one-third (Walberg 1992; Howley 1994). Simultaneously enrolment numbers grew by 500 percent. While rural schools remained small, educational facilities in urban settings often now have several thousand students (Cotton 1996). This allowed school districts to bundle their resources, combine facilities and amenities in one location and often under one roof, and streamline organization and administration of educational facilities. However, what sounds like a perfectly sensible thing to do can reach a critical point: While large school complexes have the advantage of providing a wider variety of activities, services and curricular options to students, faculty and staff, they also have disadvantages. Research has shown that both the size of the school and the size of the classroom has a significant impact on academic outcomes (Moore and Lackney, 1994, Martin 2006). The most obvious are higher levels of anonymity and a lessened sense of community resulting in places that feel more like learning factories than schools. This often results in lower student performance, social and behavioral problems and a rise of aggression and vandalism (Cotton, 1996; Lackney, 2000; Maxwell, 2003; Bergsagel et. al. 2007).

The British anthropologist Dunbar suggested that the number of people with whom one can maintain stable social relationships lies at around 150 (Dunbar 1992 & 2003). In this group size it is still possible that the individuals know each other, relate to one another and form one cohesive unit that is socially balanced. Larger groups usually require more restrictive regulations and formal organization while they are at the same time more prone to develop internal difficulties. In many cases a return to smaller administrative and physical units for schools is economically not feasible. Still the problem of overly large schools has to be addressed. As one alternative, however, the organizational and physical separation of large schools into Small Learning Communities has been successfully implemented in the last decade – even when no new school building was provided. It is not a coincidence that today's trend towards Small Learning Communities (SLC) or "Schools within a School" operate with similar group sizes as recommended by Dunbar, breaking up the large social scale of the educational entity into smaller units.

Creating SLCs within larger buildings is one option and sometimes is done by just accommodating them on one floor or housing them in separate parts of the same schoolhouse. To create these smaller entities results in a number of positive factors for which Cotton (1996) summarizes some of the most important ones:

- A tight social network among students and faculty that creates an atmosphere of responsibility (for one another, the own learning progress as well as for the provided resources) and inclusion.
- Better social identification with the group (in this case the school community), which prompts higher involvement in school activities.

- This again results in a higher level of parent involvement.
- Student and faculty have a heightened sense of efficacy.
- There is a general sense of the school as a safe haven, a place where the users like to spend time.
- The teaching is often delivered in a student-centered mode with individualized and often experimental learning activities that are relevant to the world beyond the classroom.
- Class sizes are frequently smaller.
- Both the curriculum and the teaching methodologies are more varied and cater in a special way to the individual needs, often fostering project-based group work that enables students to not only expand their academic but also their skills.

In brief, if the atmosphere within the school is more personal, people will respect and consider one another when the school community is recognizable as a smaller entity (Moore and Lackney, 1993). Students and faculty in small school or small learning communities feel accepted, perform better and show a higher level of engagement and participation (Maxwell, 2003). While in most cases a school will have more than 150 students, the grouping of classes into larger groups within the school community has been a successful concept to create smaller communities of learners within large institutions. The versatile demands of schools require this building type to offer a broad range of spaces with different atmospheres and spatial qualities. At the same time this allows the child to experience a variety of social experience that can be carefully adjusted as social skills develop and the child grows more independent.

2.3. SPATIAL ORGANIZATION OF SCHOOLS

While the primary function of a school building is to support educational processes regarding the students intellectual and cognitive development, it is also an important training ground for social and cultural skills where children are prepared for adulthood. A multitude of spaces is needed that provide good environments for the many areas of growth and learning, all fitted into the larger system of spaces (Martin, 2006). The overall orientation within the school building as well as the differentiation of distinct functional zones clarifies the hierarchical order, facilitates way finding and helps to distinguish areas for different uses more easily. To this end it is important that the users can form mental maps or images to create a connection between the self and the environment (Bell, 2006). Lynch describes the city in his book the *Image of the City*, and the same concept is transferable for schools:

Environmental images are the results of a two-way process between the observer and the environment. The environment suggests directions and relations, and the observer—with great adaptability and in the light of his own purposes—selects, organizes, and endows with meaning what he sees. The image so developed now limits and emphasizes what is seen, while the image itself is being tested against the filtered perceptual input in a constant interacting process. (Lynch, 1993, p.6)

In most schools different zones of use can be identified easily. The spatial sequence and the appropriateness of the scale for public areas (e.g. atrium, cafeteria), semi-public zones (e.g. shared zones within groups of classroom) and the mostly private areas of the classrooms itself should be rich in contrast. In the best cases they range from wide rooms with high ceilings that are used for events with large groups, for social events, sports or for theater productions via medium size spaces used simultaneously by mid-sized groups of users down to small and intimate rooms, which are used by small groups or individual students and teachers for different teaching purposes. The scale of the spaces clearly determines their character and function. “Physical and spatial aspects of a learning environment communicate a symbolic message about what is expected to happen in a particular space.” (Martin, 2006, p. 93).

A clear hierarchy of spaces is very characteristic for many schools. Today schools are broken up frequently into clusters of classrooms, which are grouped around a common shared atrium or other assembly area where the school community as a whole can come together. The central space—often spacious with good visibility from all parts—is the most public area of these schools. It usually serves

an important social function (i.e. as cafeteria or auditorium) and is closely tied to resources shared by the whole institution (gymnasium, library, computer laboratories, workshops) (Altenmüller, 2008). It is this space that connects the school, physically and ideologically, and is frequently used by the neighborhood community for other purposes outside of school hours. Consequently it functions as the threshold between the sheltered school environment and the world outside.

The physical arrangement is of high importance to classroom performance and behavior (Martin, 2006) and Gifford (1987) states that the classroom layout itself affects the social interaction between instructors and students. In contemporary schools it has become common to organize the classrooms in clusters, combining a group of classes into larger communities of learners. These teaching spaces are again organized around a central space that is visually connected to the classrooms. In ideal cases it is large enough to gather several classes at once and equipped with furniture that allows a variety of activities connected to learning and socializing. This space is an extension of the classroom and allows the circulation area to double as a work zone during instructional time and an area for social interaction during breaks. The space between this work or circulation area functions like a threshold, providing articulation and important spaces in-between rather than closing them off. It is at the same time transition and connection between places with overlapping functions. The classroom can extend out into the shared space, making the space for education larger rather than smaller (Hertzberger, 2008).

The classroom itself is the most private area and serves a manageable number of students and one teacher that forms a social entity. Familiarity among the members of the group develops quickly and the group interacts with other units nearby. The classroom serves as a home for the group – a space that is designated to this select number of people and can be appropriated accordingly. Hertzberger calls the classroom also “the home base” and later “the nest from which you can take off and you keep returning” when exploring the world (Hertzberger, 2008, p. 35). The classroom needs to provide space for a variety of learning settings, for group activity but also for individual and self directed explorations. The “articulated classroom” suggested by the Hertzberger offers a variety of zones that support different activities while providing an increasing degree of privacy and protection but without breaking up the space inwardly. The scale of these spaces gives clues about how they function best and the children quickly figure out what area they prefer for which activity.

2.4. RE-SCALING EDUCATIONAL BUILDINGS

How does this knowledge influence the architecture of schools? A simple comparison of the physical height of the user to the height of the building might already give us a first clue about how enormous a multi-storey school building can appear to a young child. To counterbalance this enormous difference in scale and provide an environment to the students that feel safe and protected it is necessary to provide an array of spaced of different scales, dimensions and heights; to break up large buildings in differentiated building parts that allow for easy orientation and identification of use and purpose that cater to the varied needs of their users.

We have to keep in mind that children work, learn and interact differently from adults and that their need for privacy also differs. While very young children do not yet have a strongly developed sense of privacy, these needs change with age (Walden, 2009). Children “live in the moment” and can retreat completely into their own imagination when they need to. Consequently, “privacy for [children] does not necessarily require solitude” (Stewart-Pollack and Menconi, 2005). The school design should cater to these needs by providing a variety of zones and settings. Break-out areas, niches and more secluded spots that are still connected to larger spaces can provide an ideal solution that allow students to withdraw from the group without feeling detached or isolated. Providing the small, somewhat enclosed spaces that are favored by children can allow them to withdraw into their imaginative world. These spaces “represent protection from the outside world” while instilling sense of belonging to a certain place (Stewart-Pollack and Menconi, 2005). Flade requests that “environments for groups should be designed in such a way as to permit control of privacy on the individual level as well as for the group” (Flade, 1998, p.58) and Walden adds to this that “every user of a public building, every student, every teacher should have the opportunity for such a retreat into a zone of relative privacy” and “if there is no opportunity for retreat, this will certainly affect human wellbeing” (Walden, 2009, p.92).

Numerous studies have shown that crowding correlates with stress symptoms, negative emotions and can lead to aggression and diminished productivity (Gifford, 1987). However, we need to remember that the objectively measured density might vary from the subjectively perceived crowding (Walden, 2009). At the same time a careful balance needs to be found as both too high as well as too low density can have a negative effect on the students, which underlines the importance of providing appropriately scaled spaces for the respective use and number of users. While in most cases the architect will not have control over class sizes or the number of students using a particular space at a given time, considering privacy needs throughout the design process and providing opportunities for “restorative privacy,” will counter-balance and prevent that “the [students’] cognitive and social development may suffer as a result” (Stewart-Pollack and Menconi, 2005).

CONCLUSION

School architecture can successfully contribute to the educational process by encouraging childhood sensory development. Understanding the actual stages of childhood development as well as how spatial perception functions and evolves can give architect and interior designers important clues to develop adequate learning environments. Consideration of size scale in school design is crucial at various levels (Walden, 2009). At an institutional level it is now widely accepted that a small learning community is advantageous for the learner. It provides a better social environment that results in a more supportive learning atmosphere (Cotton, 1996; Lackney, 2000; Maxwell, 2003; Bergsagel et. al. 2007). To cater to the students needs the building itself should be adequately articulated. At a concrete spatial level a variety of spaces with a range of different attributes offers numerous opportunities to stimulate the senses, which impacts cognitive, emotional and social growth in a positive way. It is generally accepted that inadequate or poor learning spaces affect the physical well-being and performance of teachers and students (Schneider 2003) and that the physical settings has a major impact on social interaction and academic outcomes (Schneider, 2002; Martin 2006). Material choices and furnishings can help to mediate the scale and create a positive environment that is suitable for children.

In the US the design and construction of school buildings is usually still driven by economical limitations without sufficiently considering the academic goals and principles of an institution, without sufficiently considering that teaching and learning strategies have changed in today’s information society and without sufficiently recognizing the needs of their users. Too many new schools are based on outdated social and spatial concepts that catered to a different society. While it is not necessary to create miniature worlds for students, it is more important than ever to provide learning environments that foster independent learning and social interaction, that at the same time provide a place of security and shelter while offering a variety of platforms to stimulate social, psychological, intellectual and physical growth.

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