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DESIGNING SUSTAINABLE LEARNING ENVIRONMENTS: RETHINKING THE MISSING DIMENSIONS

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ABSTRACT

There is a great deal of discussions in design, architecture, and construction circles on sustainable learning environments, and widely varying opinions as to how exactly sustainability can be introduced and approached. Recent literature indicates that the term encompasses more than the physical and economic aspects. It includes social, cultural, and behavioral dimensions. However, investigating contemporary architectural practices reveals that there are two major missing dimensions. On the one hand, there is an emphasis on the physical aspects of sustainability while socio-cultural and socio-behavioral dimensions are oversimplified. On the other hand, there is a heavy reliance on top-down policies and strategies with the aim of developing guidelines to be implemented for the betterment of learning environments. Strikingly, this takes place at the expense of other bottom-up strategies that aim at sensitizing users toward understanding the key issues underlying sustainability.

The argument of this paper is based on the belief that adopting the principles of sustainability is a comprehensive approach for a society to seek sound solutions. It calls for a responsive approach that incorporates these missing dimensions into current policies and strategies for designing and building sustainable learning environments. The paper explores different definitions of sustainability as viewed by the international community. It critically analyzes the problems associated with sustainability terminology, while comparing between top-down and bottom-up approaches to sustainability. In order to support the overall argument, the paper offers analyses of a number of real life cases that illustrate how socio-behavioral dimensions can be addressed in a collaborative design process and how bottom-up strategies can be integrated into this process.

KEY WORDS

Sustainability; Learning Environments; Participatory Design; Walking Tour Techniques; Post Occupancy Evaluation

INTRODUCTION

The last decade has witnessed a world-wide surge in the construction of learning environments. There is a growing body of support for funding school building extension, addition, renovation and new design initiatives. The rationale behind this support is based on two reasons. First, students need a healthy and safe environment that supports the achievement of pedagogical goals. Second, schools need to be cost-effective to build and operate so that public funds are not wasted. Parallel to this support, a great deal of discussion in design, architecture, and construction circles centers on sustainable design, which simply refers to designing learning environments and interior spaces with a commitment to integrate environmental needs, sound economic decisions, and human needs into a healthy and productive environment conducive to learning.

Throughout the history buildings have been viewed as a way to live or work apart from the environmental context. The culture of buildings was to modify nature and the environment to suit the needs. As population has grown building footprints and urban communities have become very large and made more so by technologies that allowed societies to alter and consume the environment at an accelerated rate. The impact of buildings on the environment and the human race was amplified by built environments that lock into inefficiency, consume virgin resources, and fail to meet human needs.

The conventional approach to create buildings has been to design human environments in isolation from the larger natural environment and social context. The results were not only negative environmental impacts, but also were built environments that fall short in supporting the people who use them.

There have been widely varying opinions as to how exactly sustainability can be introduced in the design of learning environments. Recent literature (Pirage, 1994; ECE, 1996; PNWPPRC, 1999) indicates that the term encompasses more than the physical and economic aspects. It includes social, cultural and behavioral dimensions. Investigating the contemporary architectural practices however reveals that there are two major missing dimensions. On the one hand, there is an emphasis on the physical aspects that pertain to sustainable learning environments, while socio-cultural and socio-behavioral dimensions are typically oversimplified. On the other hand -- even when these physical aspects are addressed -- a heavy reliance on top-down policies and strategies usually takes place. Despite the good intentions of the guidelines resulted from these policies which aim at the betterment of learning environments they take place at the expense of other bottom-up strategies that aim at sensitizing users toward understanding the key issues underlying sustainability.

The argument of this paper is based on the belief that adopting the principles of sustainability is a comprehensive approach for a society to seek sound solutions. It calls for a responsive approach that incorporates the missing dimensions into current policies and strategies for designing and building sustainable learning environments. Thus, this paper goes beyond the current prescriptive attitude of policy and decision makers and present actual real life experiences.

The paper explores different definitions of sustainability as viewed by the international community. It critically analyzes the problems associated with sustainability terminology, while comparing between top-down and bottom-up approaches to sustainability. In order to support the overall argument a number of real life design experiences are selected to illustrate how socio-behavioral dimensions and pedagogical objectives can be addressed in a collaborative process and how bottom-up strategies can be integrated into this process.

RETHINKING SUSTAINABILITY

The development programs of international organizations such as UN Center for Human Settlements (UNCHS); UN Environment Program (UNEP); International Union for the Conservation of Nature (IUCN); UN Development Program (UNDP), and many government agencies around the world exemplify the new way of thinking. Through the activities of these organizations ecological consciousness was raised as a reaction to the overall overwhelming global environmental degradation. During the last decade, many conferences, symposia, and colloquia have addressed the environmental issues on the policy-making levels. Law, policy, and decision makers have tailored lengthy regulations in order to maintain a sense of responsibility toward the environment. In this context, architects, designers, and engineers find themselves under the pressure of implementing those regulations. With this fast pace certain aspects emerge and act as obstacles or blocks the full understanding of the subject. These are 1) the professional attitude of recycling terminology; 2) the confusion resulting from disagreements on defining the subject; and 3) the lack of comprehensive understanding of the term. A brief discussion of these three aspects is indispensable.

The Professional Attitude of Recycling Terminology

Tracing back the trends on issues related to sustainability one can find that architects and planners are in a continuous process of recycling terminology. In the fifties, the trend was "*Good Design*", while in the late sixties and early seventies this term was replaced by "*Energy Conscious Design*." In the seventies, the oil crisis led to an increased concern for energy, but the attitude of being conscious of energy-related issues was not enough. Thus, the term was replaced and became "*Energy Efficient Design.*" In the late eighties and nineties, ecological consciousness was raised as a reaction to the overall environmental depletion, and "*Sustainability*" has been introduced as a new term associated with the fields of design, planning, and building. In the years 2001 and 2002, one notices a new term starting to appear on the surface replacing sustainability; that is "*High Performance Buildings*." Those who advocate the term claim that it covers more issues and that it is more inclusive of a wide variety of concerns (Salama, 2002).

Although recycling waste, materials, water are crucial issues in sustainability realms, the authors believe that recycling terminology is a professional attitude that has tremendous negative impact where the public do not understand the language we use and is confused about the terminology we introduce!! With this understanding, sustainability or sustainable design is simply a rephrasing of some of the forgotten values of architecture.

The Confusion Resulting from Disagreements on Defining the Subject

Recent literature avows that there are disagreements about the precise meaning of sustainability, since the term is used in many contexts including development, cities, agriculture, economy, technology, environment, architecture, planning, and the building industry. In all of these disciplines sustainability is defined differently, thereby causing more confusion. Also, the term "Sustainable Development" appears to have negative connotation because it is overused and is usually associated with development issues related only to third world countries. Many believe that the word "Development" overemphasizes economic issues and that the term does not necessarily acknowledges the importance of cultural and socio-behavioral issues (Salama 2002).

The Lack of Comprehensive Understanding of the Term "Sustainability"

Reviewing the literature on sustainability one finds two schools of thought. Some definitions place emphasis on environment and economics while others implicitly integrate social and cultural dimensions. On the one hand, the statements made by Lyle (1985 & 1993) and Davies (1994) exemplify the definitions that focus on environmental criteria. Lyle reports, *"The objective of sustainability is to provide intentionally designed and managed ecosystems that represent symbiosis of urban and natural processes."* Davies (1994) places emphasis on the same criteria but argues that *"The aim is to avoid the shortcomings in our culture in terms of the way we presently build and live, and re-introduce building as a process, which is concerned with the impact it has on the people and the environment involved."* On the other hand, the integration of environmental and socio-cultural aspects can be envisaged within the statements adopted by the international bodies. Derived from the principles developed in RIO declaration (1992), sustainability is seen as *"staying within the capacity of the natural environment while improving the quality of life and offering our children opportunities at least as good as those available to us."* The declaration of the world congress of architects (1993) reports, *"we are socially, culturally, and environmentally independent. Sustainability in the context of this interdependence requires partnership, equity, and balance among all parties."*

The demystification of sustainability as a term corroborates that it is not limited to impacts on natural environments, but on people and communities as well. It involves two domains that should not be ignored or simplified, but integrated; these are economic-environmental and socio-cultural.

> ***Based on the preceding discussion the authors assert that all of this confusion contributes dramatically to how the public values what we do, the reliability of the knowledge we develop, the credibility of the visions we introduce, and the validity of the methods we employ.***

RETHINKING THE APPROACHES TO SUSTAINABILITY

When investigating the recent literature on sustainability (Rees, 1991; Lyle, 1993; Meek, 1995; ECE, 1996; Rosenbaum, 1999; CEEDS, 2000; SBIC, 2001) one can find that there are two major approaches. The *Top-Down* approach is a term used to refer to initiatives led by the authorities or decision makers. It aims at developing policies, strategies, and standards. However, this approach has been heavily accused of being more evaluative than informative, and that it relies on forcing the professional community to be aware of issue then responds to it.

The *Bottom-Up* approach is a term used to refer to initiatives led by the community and facilitated by professionals. It aims at building public and professional awareness, while providing feedback mechanisms. It is more informative than evaluative and relies heavily on developing a common understanding, a common language, and develops a sense of responsibility toward the environment. The question that can be raised here is "Have the policies, strategies, and guidelines been transformed into real practices?" Simply, the answer is that very few examples exist, and many in the professional community agree on that. Again, the question here is why we do not find as many examples as we find this accumulation of green knowledge, developed in the last few years? The answer lies in the following argument against "Guidelines."

Guidelines are always rough, "not-illustrated", mainly address quantitative aspects, and more importantly, they do not leave enough room, or give enough direction for the creativity of the architect, the planner, or the facility manager. Guidelines are always generic and do not address specific building type and also do not deal with the building occupants. Some scholars believe that they represent the end of the process and by developing guidelines socially and environmentally responsive built environments can be realized. In this

respect, the authors assert that no guidelines are ever final; they evolve over time according to the changing circumstances. Therefore, they have to be strategically developed to respond to emerging needs and to the nature of the users. In fact, they do not provide blue prints on how sustainability can be achieved; only an expectation about the good pretty picture of what the future might be (Adams, 2002).

The bottom-up approach has also been criticized in terms of time consumption. Some argue that time invested in training programs, and awareness campaigns, is excessive. Although the results are far reaching the process consumes a lot of time while developing positive attitudes toward the environment, and reconfiguring the culture of sustainable building management and operation.

> ***The preceding argument suggests while emphasis has been placed on the top-down approach to achieve sustainability the bottom-up approach has been oversimplified or ignored. In this regard, the authors assert that both approaches are needed and none of them can replace the other.***

THE CRUX OF THE PROBLEM: SUSTAINABILITY AND THE LEARNING ENVIRONMENT

Based on the preceding arguments on rethinking sustainability and rethinking the approaches to addressing it in architectural design practices, it is crucial to have a closer look at the crux of the argument and define the problems associated with addressing sustainability in creating learning environments. Five school-specific documents discussing sustainability of learning environments were investigated and examined by employing a preliminary content analysis procedure (a list of these documents is included within the references). Despite the honest attempts and efforts of professionals to tame the accelerated growth of learning environments, a set of problems are envisioned below:

Emphasis is on the Product at the Expense of the Process

Current practices are prescriptive and employ the top-down approach, focusing mainly on the development of guidelines. They address what needs to be done and why, but rarely address how. In other words, they address the final product "the learning environment itself" without giving enough attention to the process leading to this product. In this context, guidelines and strategies are dealt with as goals not as means to achieve healthy and productive learning environments. The statement made by Ohrenshall (1999) -- an educator -corresponds to the authors' view "*It is not our goal to be a green building, it is not our goal to be an energy efficient building. Our goal to be an educational facility and the best facility we can be. Green buildings, energy efficient buildings are strategies to reach that goal*" Top down strategies that regard people as part of the process are not part of guideline development. It is crucial to incorporate those strategies that aim at sensitizing the users of the learning environment toward understanding the key issues of sustainability.

Pedagogy and the Complexity of Teaching and Learning are not Addressed

Current guidelines on sustainability of learning environments do not address pedagogical objectives, teaching methods, or the needs of learners in a clear manner. Including design features that promote learning, and that create a welcoming, aesthetically pleasing, cost effective, and environmentally responsible building achieve these. This requires an architectural program that supports teaching/learning processes, and that incorporates management and operation aspects of the learning environment. This is critical to the success of any learning environment. The statement made by Duke (1998) corresponds to the authors' view "*To build or rebuild our schools without rethinking the experiences that take place within them seems unwise as revamping teaching and learning without considering new designs for learning environments. Together, these experiences create opportunities to redesign both schools and schooling*."

Socio-Behavioral Aspects are not Integrated

Current guidelines on sustainability of learning environments do not integrate the available socio-behavioral understandings that pertain to student different age groups, where many of the critical issues are not introduced at all. The authors believe that the only way to address the needs of children or students is to understand their behavior in relation to the learning environment they occupy. Personal space, privacy, small group behavior, crowding, and density (Brody, 1975; Wiles, 1978; Hayduke, 1984; McAfee, 1987; Burgess, 1989; Black, 1993; Lackney, 1999) are among the socio-behavioral aspects that should be part of guideline development for sustainable learning environments, and more importantly should be fully addressed in the design process of those environments (Sanoff, 1994, 1995, 2001). In this respect, the authors argue that addressing the needs of those who occupy the learning environment and their behavior in the design process

is of paramount importance. A recent statement made by Sanoff (2001) corresponds to the authors view "*Building a responsive school requires that those who actually dwell in the space be part of the planning process-be they students, faculty, or community members. Not involving everyone can cripple the outcome for years to come."*

> ***The preceding three aspects of the problem accentuate the need for an alternative approach that incorporates the critical missing dimensions into a true sustainable learning environment. Doing so requires deeper understanding of pedagogical goals, teaching methods, occupants behavior, and integrating these elements into a collaborative design process that introduce applicable bottom-up strategies.***

ADDRESSING THE MISSING DIMENSIONS: COLLABORATIVE DECISION MAKING AND BUILDING AWARENESS

In order to address the missing dimensions two real life design experiences have been defined to illustrate how learning objectives together with socio-behavioral dimensions are integrated in a collaborative design process. Addressing sustainability at the bottom up level is introduced as an educational tool for school teachers to think about their building in environmental terms.

Involving the School Community in Design Decision Making Process

Involving the school community in design requires a highly intensive collaborative process with multiple layers. The process has a structured framework. However, it is characterized by being flexible to meet the requirements of different design situations. It often begins with interviews and walkthrough evaluation of the existing facility. This establishes the basis for an initial workshop where participants working in small groups write wish poems of their desires, free of any constraints. Special sessions are conducted with children or students based on the school type, these allow them to voice their opinion about their new school. Next, the school board and teachers develop a dialogue about their educational objectives, the variety of teaching methods generated from those objectives, and the types of spaces and places that would be supportive of these activities. A follow-up design workshop and a site walkthrough are conducted to explore options and design concepts, while rediscovering the site and its constraints and realities. In these workshops the basic organization of the site and the school building(s) are discussed with consensus arrived at about the future direction to be pursued.

Case 1: Davidson Elementary School

Located at the urban periphery of the city of Charlotte, Davidson community formed a vision of their new elementary school and with the help of Adams Group to accommodate that vision of an appropriate learning environment that meets the aspirations of the community. It was a positive reaction to a set of pedagogical challenges. This project won *Progressive Architecture Award* since the central design concept was to translate educational objectives into a responsive solution, and that the resultant design achieves environmental and educational objectives. Team teaching, small group interaction areas, and outdoor learning were all determining factors. Displaying the student work was achieved by creating an art spine connecting visual arts and media center to the classroom wings. The result of the participatory process with children and teachers was reflected in an unconventional school building where atria, sky-lights, bright colors, wide hallways are emphasized. One of the most striking aspects in this project is that the building image that children desired was materialized in the final design. Again, one notices the commitment of the design team to evaluate the building after it has been occupied. The outcome of this procedure illustrates how collaborative design processes would achieve educational objectives defined by the clients and users and is shown in Fig. 1. and 2.

1.

Figure (1) Children drawing expressing their desire of the future of their school

2.

Figure (2) The final image of Davidson Elementary School, a result of intensive collaborative process with school community

Case 2: Millis Elementary School

The increasing student population in the City of Guilford, North Carolina mandated the need for more learning space in Millis Elementary School. Funding was designated to offer new classrooms, resource rooms, relocated offices, upgrading of technology, and reconfiguring and adding more parking spaces. A comprehensive collaborative process has been envisioned where a major component was a post occupancy evaluation procedure for the exiting building, but this time acting as prelude for the development of the architectural program. The design team has developed a solution based on extensive research and teachers and students input in the process. Ideas that pertain to healthy environment, safe outdoor learning, parking and accessibility have been explored and defined in relation to different types of learning settings. The design solution was developed based on L-shaped classroom concept, adopting the premise that direct access to outdoor green areas would positively impact learning. The solution includes a hallway that connects the existing building to the new classrooms and to the student bus loading area. L-Shape classrooms were created as physical settings that allow for flexibility, variety of seating arrangements, provision of team teaching opportunities, and meeting different spatial needs of children. All classrooms faced south since it provides the brightest levels of daylight, and offers direct access to the outdoors, fostering additional learning opportunities. The final project sensitively interacts with the surrounding built and natural context.

The design product and process both express a set of dialogues. While the product resulted from a coherent process involving a silent-hidden dialogue between the built and the natural, the old and the new, the process involves another visible dialogue between all key players in this process. The hierarchical relationships between indoor and outdoor spaces provide a dynamic teaching-learning environment, while the L-shape classrooms enhance multiple teaching methods that emphasize trans-disciplinary learning, and recognize students' different cognitive styles and special needs (Figures 3-8).

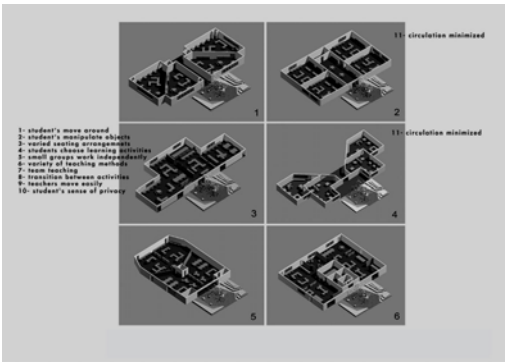

Figure (3). Classroom types presented to teachers for discussion and selection

Figure (4). Teachers in a group discussion for selecting the best classroom alternative

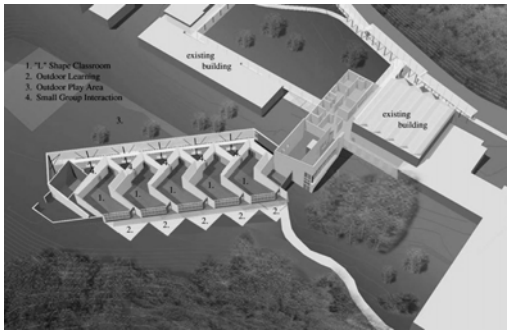

Figure (5) Relationship between outdoor learning and small group interaction areas

Figure (6) Relationship of the new addition to the existing buildings and the natural context

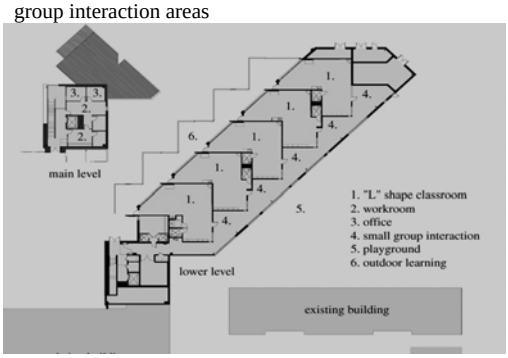

Figure (7) L-shape classrooms allowing for multiple teaching opportunities and integration with outdoors

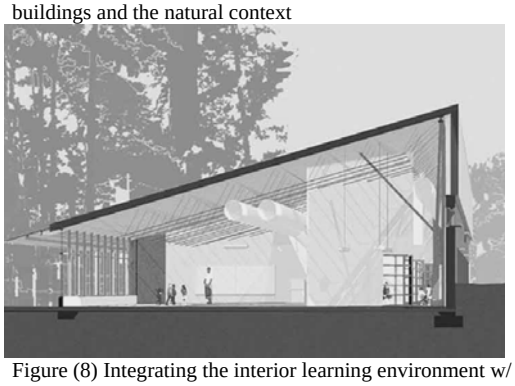

Figure (8) Integrating the interior learning environment w/ the natural context providing more learning opportunities

PLADEW: Sustainability Awareness Building Tool for Learning Environment

In order to address other important bottom-up strategies complementing the involvement of the school community in design decision making, an instrument was devised by the authors as an awareness raising tool where teachers can take a walking tour through their building. It allows them to explore, think, comprehend, develop impressions, and deeper insights into the understanding of their environment from sustainability perspective.

The tool is named PLADEW and encompasses four sets of questions to examine the key issues of sustainable planning and design. Each set of questions pertains to one of the crucial factors: 1) Planning and Zoning, 2) landscaping, 3) Designing, and 4) Energy and Waste. The following procedures outline how the tool can be implemented.

- Conducting a self-guided tour, starting by the site and the surrounding context then interior spaces (teachers may inquire about some technical aspects and get feedback from personnel in charge of the utility system and maintenance)
- Numerical scores from 1 to 5 are assigned to each question underlying the factors (1= highly appropriate, 7= very inappropriate)
- Responding to each question underlying each factor
- Analyzing the numerical ratings by computation of average scores for each factor, then computation for the overall scores of the building
- Developing concluding comments based on the overall appraisal, while highlighting positive and negative aspects

Validating PLADEW required testing it. Concomitantly, the tool was examined by delivering the tool to a sample of 40 teachers at the Carmel Christian School in Mathews, North Carolina. Teachers were asked to take a walking tour and assess their school building according to the questions underlying the four factors. It should be noted that for the specific purpose of this research the objective was clearly to test the tool not to reach a conclusion about the existing status of Carmel School.

Teachers were also asked to provide their feedback concerning any ambiguity of the questions or the terminology used, and also to add any questions they feel they are critical to be addressed. 15 teachers responded and few of them noted that they had difficulty understanding some of the terms. As a result a glossary of definitions was added to the tool and included definitions of terms such as buffer zone, site

topography, gray water system, building shell …etc. The following sheet illustrates the four factors and the underlying questions.

Factor 1: PLANNING AND ZONING **Highly Appropriate 1 2 3 4 5 Very Inappropriate**	**Score**	**Factor 2: LANDSCAPING** **Highly Appropriate 1 2 3 4 5 Very Inappropriate**	**Score**
1. How does the building suit the most appropriate use of the surrounding area? **2.** How does the building encourage teachers, students, and visitors to respect the surrounding natural environment? **3.** How does the building encourage fostering and enhancing environmental education and awareness? **4.** How does the project alter or change the site topography? **5.** How does the orientation of the building and its components fit well with the orientation of the site and the climatic constraints? *(consider the sun path and north-south orientation, day lighting).* **6.** Is there a buffer zone around the site, and if so, is it suitable for protecting any surrounding significant natural features? **7.** Does the access to the site fit well with the existing natural landscape? **8.** Do the pedestrian paths and their angles of vision correspond to the natural scenes (if any) around the site? **9.** Are the entry points sufficient, easily accessible, and suitable for building size, no. of students and teachers, site area, and dimensions? **10.** Are the entry points appropriate for minimizing any negative impacts on the surrounding natural environment? **11.** Are the motorways around the site suitable for and respecting the surrounding environment; natural and built? *(consider width of motorways and speed limits, safety aspects,…etc.,).* **12.** How does the project introduce any damaging, polluting, or waste generating activities?		**1.** How effectively are the site features kept? *(consider leveling, excavations, and land filling).* **2.** Does the landscape design integrate the site with the surrounding environment? (is the site surrounded by fences, if so, consider the materials used for fence treatments). **3.** How effectively does the design of landscape items avoid the use of synthetic materials? *(consider the materials used for walkways, and the asphalt pavements of the parking area)* **4.** Does the project introduce soft-scape elements (natural plants and shrubs)? If so, how effective? *(consider their harmony with the existing natural environment, and correspondence to climatic conditions).* **5.** How effectively is the site furniture items (seats, pergolas, garbage boxes) installed in and distributed within the site? *(consider their location, materials, and manufacturing).* **6.** How well are the routes around and within the site marked? Are the markings clear and easily understood? *(consider directional signs, their location, content, and material).* **7.** Are there any signs for environmental education purposes? If so, how effectively they convey messages about appropriate behavior? **8.** Are the pedestrian paths and other hard-scape elements made of natural or recycled materials? **9.** Does the site have a re-used water system (gray water)? If so, How effective? *(consider capturing rain water and re-using it for plants, or any other purposes)* **10.** How effectively does the project introduce native plants that require least amount of watering?	
Average = Sum of Scores/12		**Average = Sum of Scores/10**	
Factor 1: DESIGNING **Highly Appropriate 1 2 3 4 5 Very Inappropriate**	**Score**	**Factor 1: ENERGY AND WASTE** **Highly Appropriate 1 2 3 4 5 Very Inappropriate**	**Score**
1. How effectively does the architectural program consider the appropriate activities and space requirements and standards required for accommodating these activities? *(consider the nature of the curriculum and students and teachers' needs, classroom shapes, integrating indoor learning and outdoor activities…etc.)* **2.** Is the architectural form designed in harmony with the natural landscape and the surrounding physical setting? **3.** Does the design of outdoor elements allow for interaction of students and teachers with nature *(consider roof garden design, terraces, and verandahs, semi-covered outdoor areas).* **4.** How effectively does the design provide visually appealing interior environment? *(consider classroom paintings, expression of materials, interior plantations, and day lighting).* **5.** How effectively does the interior design consider aspects associated with human comfort? *(consider the degree of natural lighting in classrooms, the design of teachers' work areas, students absenteeism…etc.).* **6.** How effectively does the design of the building allow for achieving acoustical quality and hearing privacy? *(consider noise around classrooms, separation between learning and recreational activities…etc).* **7.** How effectively does the design of the building consider aspects that pertain to indoor air quality? *(consider naturally ventilated areas vs. artificially ventilated areas where AC is used)* **8.** How does the design of the building employ ecological design techniques? *(consider orientation and aspects that pertain to solar energy, natural ventilation, lattices and shades on windows, natural lighting).* **9.** How does the design of the building allow for maximum natural lighting for interior space? *(consider this only in classrooms)* **10.** Are the building components placed apart (but integrated) so as to allow for natural growth of vegetation and wild life movement? **11.** How does the capacity of the building correspond to site features and the surrounding natural context? *(consider built up area, density, number of students, teachers and cars).* **12.** Does the design allow for the ease of maintenance, cleaning, and repairing? If so, how effective?		**1.** Was the building designed in a manner that saves energy embodied during the construction process? *(consider the materials used in the building, Are they locally produced, if not, from where they were transported).* **2.** Does the design consider the use of photovoltaic system to generate electricity as primary, secondary, or integrated with the regular power source? *(Photovoltaic systems are units that utilize the renewable energy (sun radiation) in lighting or in other electrical and mechanical systems in the building).* **3.** To what extent does the design of the building shell avoid exposing the exterior walls to direct heat gain *(consider north- south orientation, wall thickness, wall material, and insulation).* **4.** Is modern technology employed for energy and water savings? *(consider the use of light sensors, solar tanks, and taps that work automatically).* **5.** To what extent does the design of the building avoid high-energy consumption and the use of hazardous materials? **6.** Is waste recycling system working well? *(consider drainage system, and separation of waste, paper, glass, aluminum cans, cardboard…etc.,).* **7.** How effectively is the water recycled via different uses in the operation process? *(consider water source, recycling process, and the use of gray water for irrigation).*	
Average = Sum of Scores/12		**Average – Sum of Scores/7**	

THE VOICE OF THE AUTHORS: PROLOGUE FOR THE FUTURE OF LEARNING ENVIRONMENTS

This paper has provided a comprehensive understanding for addressing sustainability in the design of learning environments. Realizing the dramatic negative impact of how the public values efforts of the professional community the paper analyzed the dilemma associated with the definition of sustainability. The paper argued for need for integrating top-down and bottom-up strategies when addressing sustainability.

The results of the preliminary content analysis of five school specific documents that discuss sustainable learning environments reveal three crucial aspects, characterized by placing emphasis on the product at the expense of the process, and not addressing both the complexity of the educational process, and the teachers and students behaviors and needs. In response, an alternative approach for addressing the missing dimensions is envisioned by introducing collaborative decision making and awareness raising as factors critical to the creation of successful sustainable learning environments. Two cases adopting the principles of this approach accentuate the need for integrating pedagogical objectives, children behaviors, and occupants' needs into other physical elements that enhance the educational process. PLADEW, a sustainability awareness building tool for learning environments is envisaged acting as a bottom-up strategy that complements the participatory design process.

The arguments and cases presented in this paper corroborate that an alternative architect role is emerging, replacing other conventional roles. This role goes beyond adopting prescriptive measures for addressing sustainability, and goes beyond superficiality in addressing teachers and children needs and wants. The role is envisaged to provide a bottom-up, participatory, educational, enlightening, and exploratory process. The authors assert that only by addressing the missing dimensions of sustainability responsible learning environments can be created and creative teaching/learning process can be fostered and enhanced.

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- Best Practices Manual. Vol. 1, 2, and 3: Collaborative for High Performance Schools, California. http://www.chps.net
- Sustainable Schools: Innovative Design. http://www.innovativedesign.net
- Partnership for Resource-Efficient Schools; Recommended Best Management Practices: Seattle Public Schools, Washington State. http://www.ci.seattle.wa.us/utill/rescons/susbuild/partnership.htm
- High Performance School Buildings: Resource and Strategy Guide: Sustainable Building Industry Council. http://www.sbicouncil.org/home/index.html