

Inner space elements in environmentally responsible interior design education

Magdalena Celadyn

Academy of Fine Arts in Cracow
Kraków, Poland

ABSTRACT: In this article, the author analyses issues concerning the implementation of educational methods regarding environmentally responsible interior design at academies of fine arts. The existing *green design* teaching model is usually limited to theoretical courses on sustainability in architectural design, and the issue requires a more systematic and practical approach. The basic point of the proposed teaching methods for the creation of a sustainable indoor environment is a concept of internal structural elements, as these are important multi-functional structures in the strategy of environmental responsibility in interior design. The formal and functional integration with building components may enable a rational and effective use of building materials and products, and help to optimise the quality of the indoor environment. The evaluation of interior elements using analysis of inner space structural elements as assessment tools may become important in implementation of principles of environmental responsibility in the educational programmes of sustainable interior design. This may be an introductory move towards the full understanding of integrative design process.

INTRODUCTION

The analysis of design decision making processes for creation of a sustainable indoor environment indicates that many professionals of different specialties (e.g. climate engineers, consultants on green buildings), make contribution to the outcome, but...*there are significant steps that an interior designer can take to improve (building) performance* [1], with equally important optimisation of occupants' working and living conditions. Interior designs may meet this expectation on the condition that...

...some fundamental principles are integrated into design thinking, then the accumulative effect will be considerable [1].

The involvement of interior designers with integrated design teams from the preliminary stages of the design process, and the implementation of sustainability imperatives into their projects is essential [2]. This methodology may result in the improvement of indoor environment quality, correct management of resources through careful spatial organisation, reduction of usage of energy and water consumption, minimisation of operational costs, as well as in the reduction of the negative impact of buildings themselves and the users' activities on natural environment. These requirements concern the creation of newly completed spaces, as well as retrofit conversions of existing modernised and adapted spaces.

Interior design departments, which in Poland are traditionally affiliated with academies of fine arts, due to their involvement in, and dedication to, questions of space creativity research, provide students with sustainability terms, mainly through conventional knowledge-based learning models. Existing *green design* teaching activities and the methods presented there, are usually limited to theoretical, facultative one-semester courses on issues of sustainability in architectural design. They are mostly based on multimedia lectures, occasionally followed by discussions led by students over the analysis of selected representative case studies. Incorporation of sustainability into the undergraduate and graduate interior design curriculum, to provide students with a comprehensive understanding of what constitutes an environmentally responsible design, demands substantial curriculum modifications and adjustments.

Skills developed by students, because of modifications introduced into the interior design education programme, should enable them to address interconnectedness of sustainability problems in architectural practice creatively [3].

Sustainability should be understood by interior design students as a significant criterion for selecting and specifying suitable building materials for the formal creation and organisation of inner spaces. By gaining abilities to apply sustainable solutions into their projects consistently, designers may be able to predict and systematically verify possible results of decisions taken over the inner space or building life cycle.

Designers are active participants in integrated design teams collaborating with other interdisciplinary professionals. Properly chosen educational methods concerning the sustainable design strategy completion enable interior designers to develop a critical assessment of their proposals for providing and maintaining an appropriate indoor environment for the occupants, in a wide environmental context. This perspective considers the issues of the quality of the indoor environment, particularly in terms of occupants' health and well-being, as well as the ecological consequences of mutual interaction between man-made and natural environments [4][5]. A methodology regarding the revision of traditional concepts of educating for sustainability in interior design is discussed in successive sections of this article.

FUNCTIONAL INTEGRATION OF INDOOR STRUCTURAL ELEMENTS

The framework of the suggested teaching method is to indicate that green indoor environment design may assure synergy between *mechanistic* solutions leading to energy efficiency, and formal interior design *ecological* decisions complementing them through the improvement in human-responsive indoor environment working and living conditions. The basic point of proposed teaching methods for creation of a sustainable indoor environment is a concept for the evaluation of inner space structural elements through their contribution to the valuable indoor spatial organisation as *...products can be used efficiently by serving more than one function* [6].

The proposed classification includes the following indoor elements and is related to their performance: external walls, determined as enclosures separating inner space from the natural environment and actively responding to changing climate conditions; suspended ceilings; raised floors; partitions and spatial dividers; internal finishing; and equipment and furnishing specially designed and produced according to individual users' needs.

Comprehensive and simultaneous examination of internal structural elements through their formal aspects, functional complexity and related adaptability, as well as technical methods of their execution, play a substantial role in the strategy of environmentally responsible interior design, especially of work environments. Formal and functional integration of inner space elements with existing building components, along with their multi-functionality, are design imperatives that may be assessed in economic, ecological and psycho-social contexts.

Integration of building structural components with indoor elements and the multi-functionality of these elements, as major design demands, may provide a completed inner space with: 1) an effective use of building materials and products, as well as rational space planning (e.g. standing individual workstations in open space, installed around construction studs becoming natural visual and subjective separating baffles); 2) proper management of building materials (e.g. reduction of adhesives in favour of mechanical joints enabling potential reuse of disassembled parts, and modularity allowing easy replacement of damaged elements); and 3) optimisation of the quality of the indoor environment through the supplementation of the performance of building technical systems (e.g. implementation of indoor green walls, in the proposed method of evaluation of inner space elements (referred to as biological baffles), may enhance the effectiveness of the ventilation system and air purifying devices).

An exemplary diagram is shown in Figure 1. This is to be worked out by students during workshops, regarding the initial phase of assessment of sustainable design approach to the creation of indoor elements, with vertical space enclosures and spatial dividers as the subject of examination.







Form						
	Solid baffle	Transparent baffle	Perforated baffle	Biological baffle	Subjective space divider	Climatic baffle
Function	Acoustic insulation Visual insulation of workstations	Acoustic insulation of workplaces Daylight transmission Spatial continuity	Acoustic insulation of workplaces Spatial division	Acoustic insulation Visual insulation Indoor air parameters regulation Internal space division	Internal space division Subjective exclusion of space of different usage	Acoustic insulation Visual insulation Indoor air parameters regulation Internal space division
Execution	Framework walls with finishing cladding Stationary and mobile screens	Transparent glass panes LC blinds integrated Translucent glass panes	Panels, screens Selfsupporting buffers made of sound absorbing materials	Vertical indoor garden mounted on separate construction	Strips, lines suspended to ceiling	Laminated safety glass Panels with water falling down to separated tank

Figure 1: Interior elements in sustainable inner space. Space enclosures and spatial dividers.

In order to examine the features of sustainable interior element, students start by assigning different possible functions to these elements, in accordance with functional exigencies, properly chosen materials and execution methods.

Recognition of the basic and auxiliary functions related to improvement in space performance that the inner space elements are supposed to fulfil, may be essential for gaining an understanding of sustainability principles. This indication of the functional and formal complexity of elements may become fundamental for the development of a passive mode design approach of interior elements. This is important from ecological and economic points of view, and supports technical, as well as technological solutions.

DESIGN STRATEGIES FOR INDOOR ENVIRONMENT ELEMENTS

Further detailed evaluation of indoor elements in environmentally responsible interior design may concern recommendation of sustainable design strategies for elements. They concern issues regarding: 1) the demand of resources' conservation and rational materials' management, based on the reduce-reuse-recycle-recover formula; 2) endorsement of the indoor environment's quality with the focus on occupants' health; and 3) enhancement of building systems performance and related reduction of operational costs.

The product, which can be understood as internal element reuse and be considered as being equal to an extension of its life cycle may be realised in practice through its complete removal and placement in another spatial context, in accordance with its newly-assigned functions and due to the broader usage of demountable mechanical connections. Reclaimed products may become parts of furnishings or finishes of the structural modules serving to construct new spatial structures.

Dematerialisation of internal space elements may be considered to be another more radical and sometimes controversial method of realisation of a strategy for the reduction of resources with additional savings in the space volume. This design method, demanding significant reduction in the amount of materials used without any deterioration of the space's performance or aesthetic values, may impose an additional role on elements as a specific sustainability educational tool, giving an inside view into the elements' structure.

A strategy for the improvement of the quality of interior microclimate may comprise a careful choice of certified materials or implementation of biological components actively responding to these demands as passive mode design devices. This includes the regulation of inner temperatures and optimisation of air parameters (including humidity and carbon dioxide level).

In the strategy adopted to enhance building systems, the analysis of the possible minimisation of electrical energy used for artificial lighting may suggest the implementation of technically advanced and formal methods enabling effective use of daylight. It pertains, especially, to working areas and can be realised through the placement of inner translucent light shelves, integrated with external glazed façades and supplemented with reflecting ceiling, floor and inner concentrating mirrors. These enable transmission of daylight to workstations located some distance away from glazed envelopes and improve working conditions.

The proposed research scheme, being a part of the workshops programme, is presented in Figure 2. This regards the contribution made by indoor elements in realisation of the sustainability of indoor environment strategies, with space enclosures and spatial dividers in the form of vertical perforated baffles as samples.

■	Interior environment elements' design strategies
■	Interior design strategies for resources' conservation
■	Durability of structures and products
■	Reduction of amount of used sources
■	Recovery for reuse and reintegration
■	Recovery for recycling
■	Interior design strategies for IEQ endorsement
■	Reduction of VOC
■	Regulation of inner air humidity
■	Regulation of inner air temperature
■	Acoustics optimisation
■	Interior design strategies for systems' enhancement
■	Daylighting transmission and penetration
■	HVAC efficiency endorsement
■	Artificial lighting efficiency endorsement

Figure 2: Interior elements in realisation of sustainability design strategies.

A comprehensive examination of options for realising sustainability design strategies through careful placement and formal creation of indoor elements, proves their influence on modification of physical characteristics of space. An appropriate implementation and execution of these internal forms, based on environment improvement considerations, assures their integration with other technical and technological measures taken to comply with sustainability imperatives. This method, consistently pursued in relation to every space element, may have an immense impact on both the spatial integrity and stylistic identity of the built environment [7].

ASSESSMENT OF POSSIBLE ELEMENTS' PERFORMANCE

Studies on the complexity of spatial elements and the improvement of indoor environment parameters should be continued by students through research based on a given layout of the reference space. This should be complemented by several simulations, models and analysis of alternate spatial and structural concepts of internal elements with regard to the modes of accomplishment of environmental design strategies assigned to them. The formal, technical and structural aspects of designed components should be emphasised.

The assessment of performance of inner space elements, based on their structure and predictions resulting from research findings, may become the first step towards the development of main guidelines for environmentally responsible interior design, in the subsequent stages of design process. A significant role should be assigned to managing materials used in inner spaces and this should be understood in the most comprehensive sense [5]. The focus should always be on reduction of the volume of materials required and, therefore, the elimination of potential waste, being a result of dismantling of products or demolition of building components [8]. These requirements for materials implementation are related to the volume of the elements of the built environment: structure, methods of assembly and finish. Criteria for materials selection should first refer to their physical and chemical characteristics, as well as their impact on indoor environment quality, including reduction in the volume of indoor air pollutants and volatile organic compounds, something that is essential for occupants' well-being and comfort [9].

Analysis of element structure and joint assessments applied may be useful for calculating the scale of composites used, estimation of the number of recyclable components or indication of their recycled content. These features, analysed in relation to the different building materials to be used, may be collected in comparative tables. Conclusions drawn from them may lead to the first assumption regarding the choice of specific materials and their influence on a product's (i.e. space element) performance (in terms of cost reductions due to their dismantling, upgrading or re-filling). Therefore, the strategy for resources conservation is directly connected to the methods of creation of inner space main elements.

Issues of improvement in internal performance achieved through the careful introduction of elements with direct reference to utilised materials' characteristics may become the subject of yet another assessment related to the accomplishment of the strategy of the enhancement of major building systems including: the electrical system, heating, ventilation and air conditioning systems. Qualitative model analysis of inclusion of vertical space dividers made with recycled perforated plastic, in daylighting transmission into remoted and mobile workplaces, situated in an open space, and improvement in working condition and related optical comfort is shown in Figure 3.

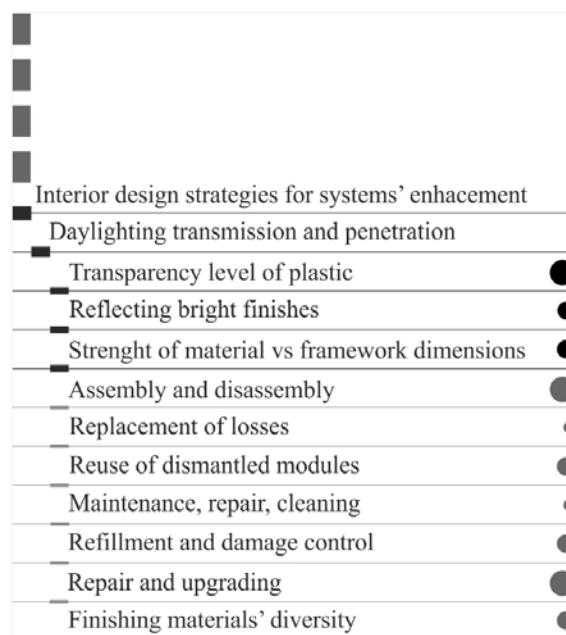


Figure 3: Initial design phase assessment of inner space elements' structure and performance. Space dividers, in a form of vertical perforated baffles, as passive-mode sustainable interior design components.

This examination has been based on predictions derived from evidence and a case-study model, and may prove that a concept for sustainable spatial elements based on their multi-functionality assures multi-level profitability. Properly and carefully designed partitions and dividers may augment the amount of daylight at workstations and stimulate visual and optical comfort, thus, assuring users' psycho-social comfort. These spatial elements may result in economic savings due to diminished use of artificial light.

Assessment of the relationship between the values of resources and of the opportunity for their assembly, as well as modification improving performance, may inspire broad formal and functional research, and result in even deeper integration of indoor elements into a cohesive environment and human-responsive system. The studies should provide recommendations concerning design research and data collection methods in interior design. These should indicate execution methods for indoor elements selected according to their sustainability-oriented characteristics that include traditional building techniques, as well as innovative technology solutions. These are the most appropriate techniques for passive-mode sustainable interior design components.

CONCLUSIONS

Identification of the need for a competence-based sustainably conscious interior design curriculum in educational programmes offered by academies of fine arts allowed for the establishment of a new inquiry-based, practice-oriented design teaching methodology with appropriate selection of quality criteria. The methodology presented in this article, applied to supplement the existing interior design programme, consists of developed and comprehensive assessment systems of internal elements. They were considered in the context of their potential and contributions in the creation of sustainable indoor environment.

The assessment schemes, concerning the multi-faceted evaluation of selected interior elements, have illustrated the potential research assessments undertaken by students of interior design courses to achieve an environmentally responsible design. Cohesion of the design of interior elements, as called for in the students' interior design educational programme, may be described as essential for accomplishing the sustainability paradigm in the built environment.

With regard to the possible technical, material and formal solutions, the tables classify the chosen interior elements as relevant structures in modification of optical, visual, thermal and acoustical parameters, being essential characteristics of indoor environments. Through this method, students develop sustainability skills and competencies. They consciously apply sustainable solutions to their designs and acquire better understanding of properly conceived inner space elements as important factors in achieving a satisfying performance of buildings and the users' comfort, and finally they...*assess all the consequences of their decisions over the project's life cycle* [6].

Evaluation of interior elements, made with these assessment schemes and incorporated in the teaching process, may lead to the broad definition and presentation of sustainable inner space design problems, being at the same time an introduction to the full understanding of what constitutes an integrative design process.

The highlighted method may become important for the incorporation of the principles of environmental responsibility into interior design educational programmes at fine arts academies. This may serve as a tool to identify the complexity of issues related to sustainability of the built environment and to assign an active and considerable role in solving of associated problems to interior designers. Being a basic design instrument in the quest for consistency in the sustainability educational programme, this tool may provide additional value as stimulating unconventional, innovative, but still environment-focused formal proposals for inner spaces.

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