

Resource-efficient sustainable design as a leading interior design guideline

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ABSTRACT: The author has investigated the possibility of adjusting existing interior design education to reflect a broad spectrum of sustainability strategies of resource efficiency and waste management effectiveness, to form an environmentally responsible and healthy indoor environment. The issues discussed arise from the recognition in interior design teaching of the environmentally sustainable design principle of resource efficiency, and the proposal for modifications to the teaching programme to effectively include this into students' design projects. The author has proposed that students develop projects within joint practical modules of Building Construction and Environmentally Sustainable Architectural Design. Both courses are run by the author. Students were to address in their projects, primary sustainable interior design principles of reduction in resource consumption and minimisation of building waste production. Innovative design methods were required to fulfil these requirements, including introducing reclaimed building materials and products into interior space components.

Keywords: Sustainable interior design, environmentally responsible interiors, resource efficiency, building waste management

INTRODUCTION

Necessary modifications to interior design education programmes are occurring to reflect sustainability concerns of inner spaces and their components [1]. Sustainability design methodology requires systematised knowledge gained through education. Interior design teaching in Polish higher education addresses the sustainable considerations of resource efficiency and waste management in a disconnected and inadequate manner.

The Kang and Guerin statement that *environmentally sustainable issues in interior design are based on the sustainable design principles and strategies common for the built environment* [2] indicates that necessary adjustments in the interior design curriculum should reflect requirements built into the architectural teaching framework, and the application of sustainability strategies assigned to architectural design. Since interior designers *are beginning to address the environmental issues as they acknowledge the importance of sustainable interior design* [2], interior design learning should raise the environmental awareness of interior designers, providing them with comprehensive knowledge of the multi-dimensional aspects of sustainable design. This includes a reduction in resource consumption to lower the negative impact of the interior environment on the natural one.

The main purpose of the research reported here was to recommend further modifications of interior design curricula to promote systematised knowledge of sustainability and provide students with appropriate design methods and tools, as already proposed by the author in previously published papers. In particular, environmentally responsible building materials management principles should be explored. These adjustments have been incorporated into workshops within practical parts of the building construction and environmentally responsible architectural design courses, both delivered to undergraduate students.

The objective of a modified interior design curriculum is to enable interior design students to recognise sustainable design strategies of resource efficiency and waste management effectiveness as leading approaches in forming sustainable interior spaces and design guidelines. A study was conducted to encourage students to *learn to use less and to use what is available, rather than always creating specific, new components and materials that require more energy and resources, and thus have a greater detrimental impact* [3] on the natural environment. Investigated also was the design for resources efficient interiors (DfREI) concept in pursuing sustainability principles, and a search for the ecological aesthetics of the indoor environment.

RESOURCE EFFICIENCY IN THE DESIGN OF INTERIORS

Thomsen et al opined that *waste is increasingly considered as another form of resource* [4] and should be considered within the life cycle of the whole building, as well as interior spaces and their components. For Reed, *sustainability, as currently practiced in the built environment, is primarily an exercise in efficiency*, being focused on doing *less damage to the environment* [5]. Reed, referring to the environmental multi-criterial evaluation schemes as supportive design tools to accomplish sustainability, indicates the importance of these design instruments along with other mechanisms to achieve *a reduction in the damage caused by excessive resource use* [5] in architecture and design.

Sustainability in design involves, proffers Walker, *resourcefulness and restraint* [3], exploration of the reuse, as well as remanufacturing of building materials and products. Resource efficiency and building waste management effectiveness, therefore, are becoming the environmental markers for single and multi-functional sets of objects. These environmentally responsible approaches facilitate carefully developed and strictly executed designs for resource-efficient interiors.

Design for deconstruction or the *selective dismantling concept* [6], based on the carefully provisioned management of available resources, enables the optimisation of product performance, and thus responds to the cost-effectiveness of design methods. Design for adaptive reuse provides an opportunity to reintroduce into newly designed components, reclaimed or salvaged building materials or products from the refurbished or demolished building. Design for the exposure of the structure of introduced building materials and applied treatment methods with limited amount of finishes, are to verify the rightness of the provocative statement that: *the most green interior finish is no finish at all* [7]. Design for the reintroduction of building construction or demolition waste, with adjustments of planning procedures, as well as design solutions *according to what becomes available* [8], are a response to the demand for reducing post-construction waste.

All the design methods mentioned above promote the affordability and availability of resources. The manufacturing processes and dismantling practices are all relevant in accomplishing sustainable design resource savings in architecture and interior design.

RESOURCE EFFICIENCY IN THE INTERIOR DESIGN TEACHING FRAMEWORK

Sustainability objectives of resource efficiency and waste management in interior design are within the existing curriculum, but in a disconnected way. Therefore, similar to other sustainability concerns (e.g. improvement of indoor environmental quality with appropriate spatial arrangement of interior components or specification of building materials without volatile organic compounds), the idea of control of resource consumption regarding completion of the interior are viewed by students as being separate issues.

At present, the existing interior design teaching framework, offers to students just a facultative lecture course on Environmentally Sustainable Architectural Design, which discusses the impact of the sustainability paradigm on the integrative interior design process. This does require modifications to provide students with a comprehensive approach to sustainability requirements. The modifications are analysed further in this article and supplement the author's proposals in previous publications [9-11]. These are an attempt to develop a comprehensive education scheme for environmental interior design, within the existing and well-established educational framework. The effects are discussed in the paper of the students' design projects developed within joint workshops led weekly during one semester, with emphasis on the validation of resource-efficient sustainable design requirements as a leading interior design guideline.

METHODOLOGY

The objective of the study was to verify the inclusion of joint workshops, conducted by the author, into the interior design teaching programme, as supportive learning activity. Workshops organised within the project-learning part of the Construction Building course were a supplementary tool to build up a comprehensive and systematised knowledge on sustainability of control over resource consumption. This teaching instrument helped to verify the value of resource efficiency as a leading sustainable interior design guideline. The students were to apply in their projects the knowledge acquired from theoretical modules of these courses, delivered by the author, and elaborated within joint practical design modules of Construction Building and Environmentally Sustainable Architectural Design.

The integral element of the study, to complement the design process, was a survey conducted among students participating in this special class, based on open-ended questionnaires. The aim of this set of questions was to assess the students' scope of knowledge and understanding of the meaning of resource efficiency, as well as the interrelated waste management effectiveness demands in the creation of interiors.

CASE STUDY

The selected group comprised six students, out of a total of 22 third-year undergraduate interior design students. All students attended the facultative course Environmentally Sustainable Architectural Design that covered the

fundamentals of environmental sustainability strategies and analysis of design methods. The selected group of six were invited by the author, the project co-ordinator, to develop their semester design projects within experimental joint workshops. The projects were developed within the project-learning module of the Building Construction compulsory course, and the practical part of the Environmentally Sustainable Architectural Design elective lecture course, both delivered by the author. The subject of the students' design projects was development of an environmentally responsible co-working space assigned to selected start-ups in the existing commercial centre. To meet the sustainability requirements, a spatial layout featured an activity-based workplace model that conformed to the sustainable principles of optimisation of psycho-physical comfort of occupants, water and energy savings, as well as resource efficiency and waste management effectiveness to reduce negative impact on the natural setting.

The students were encouraged to apply different modes of presentation that comprised the following:

1. Perspective drawings, to give an overall idea of the designed setting and interior components.
2. Drawings of buildings to explain the technical aspects of proposals, with emphasis on fulfilment of sustainability requirements.
3. Resource drawings [12] or visuals [11] to explain the environmental context of interior components, so as to involve occupants in sustainable practices (e.g. evidence of location of containers for collection of post-consumer waste to recycle; indication of components structure with recycled content).
4. Schemes and diagrams to illustrate the presence of sustainability requirements as design guidelines.

The survey conducted among the students participating in the workshops was based on the two-section questionnaire. It was developed to measure the consequences of exploration and development of design methods applied in their design projects of interior space, to control consumption of building materials and products. In the close-ended section of the survey students were asked to express their reflections on the following problems:

- Did the range of design methods oriented to resource effectiveness increase students' interest in the accomplishment of other sustainable requirements?
- Did the design methods change students' personal attitudes and habits towards functionally, formally and economically justified consumption of building products to complete interiors and their components?
- Did the interior design students consider applied interior design methods as an efficient means of control over materials consumption, and thus worth to be recommended among designers?

In the descriptive section of the survey the students were to present their opinions on the following issues:

- Which outcomes of inclusion of the resource consumption beliefs in the interior design process were identified by the students as mostly beneficial?
- How the resource efficiency design strategy applied to the forming of interior space changed students' understanding of the environmental context of interiors.

The main goal of this design process was to provide students with design methods and tools to apply the theoretical knowledge on sustainability through the project-based learning, with an emphasis on lowering the negative impact on the natural environment. The research study objective was the development of design methods for the accomplishment of the DfREI in fulfilment of sustainability principles, as well as their practical application by the students in their design projects.

The proposed design methods to comply with the sustainable requirement of reduced consumption of resources were to verify the possible effects of the established resource-efficiency concept on changes in occupants' behavioural attitudes and habits, as well as on the aesthetic identity and formal integrity of created interiors. Results of the design projects along with answers given by the students to the questionnaire, were to verify the outcomes of the learning method and tool, and thus to confirm the inclusion of the resource efficiency design strategy, along with optimisation of indoor environment quality, into the modified and sustainability-oriented interior design curriculum.

DESIGN FOR RESOURCE-EFFICIENT INTERIORS

Design strategies proposed by the students were assessed for compliance with sustainability requirements, as encompassed in the reference regarding multi-criterial environmental evaluation systems. Sustainable approaches concerning the resource-efficiency principle, in the materials and resources rating system for the basic category of beliefs, were recognised by students as the second most decisive for interior high environmental impact performance, along with optimisation of indoor environment quality.

The proposed approaches, referring to the DfREI framework, comprised the following:

1. Design for direct control and reduction in resources consumption.
2. Design for deconstruction and disassembly [13] of interior constitutive components parts.
3. Design for direct reuse or adaptive reuse in both intra- and inter-setting context [14].

4. Design for repair and upgrading.
5. Design for recyclability, and with building materials of recycled content.

The exemplary innovative design methods to accomplish the sustainable approach to design for direct control and reduction in resource consumption, employed by the students, can be divided into three main categories. The first group oriented to savings in resources extensively exercised by the students in their design projects was supplemented with research on the control of the volume of constitutive interior components and the amount necessary to accomplish functional requirements. Added to this was the concept of a revision of conventional finishing materials. The students' studies concentrated on the following:

- Dematerialisation, understood as substantial decrease in amount of resources necessary to complete the interior component without deterioration of functionality.
- Reduction in the amount of finishing materials introduced to complete components (see Figure 1) with exposure of materials structure appropriately protected to assure occupant safety and product durability.
- Restriction in the volume of introduced interior components, while recognising their principal and supplementing functions, and responding to the occupants' needs.



Figure 1: Resource-efficient sustainable design principle as a leading guideline for interior design components. Study on the reduction in finishing materials. (Author: K. Milchina; Supervisor: M. Celadyn; source: Archive of the Faculty of Interior Design, *Jan Matejko* Academy of Fine Arts, Kraków, Poland).

Exemplary design methods assigned to the *design for deconstruction and disassembly group*, emphasised the forming of components to extend the lifespan of building products, as well as the interior components. The students investigated different spatial configurations of designed artefacts, as well as modes of their assembly. Their proposals were aimed at facilitating the future adaptation of spaces with direct reintroduction or adaptive reuse of introduced components, and thus avoiding production of building waste due to multiple refurbishments. Design methods explored by the students included the following:

- Multi-functionality of structurally developed interior constitutive components (e.g. seats, space dividers, containers for office stationery).
- Flexibility of interior components accomplished with appropriate technical solutions based on a broad exercise of modularity, as well as adjustability in volume.
- Assembling techniques of a part in a component that allows dismantling for further modernisation or reuse in other spatial or functional contexts.
- Selection of building materials and products of low degree of processing to facilitate further direct or adaptive reuse of them.

The next category in the execution of the DfREI; namely, the design for *direct reuse or adaptive reuse group*, provided students with the opportunity to study the methods and results of the reintroduction, into the indoor environment, of reclaimed or recovered building materials or products as construction waste. The exemplary design methods to explore the formal and structural potential of this approach, as applied by the students included the following:

- Reintroduction of building materials and products acquired from structural components of refurbished or demolished buildings into the interior components structure, to accomplish an *inter-setting adaptive reuse* design concept [14].
- Reintroduction of building materials and products acquired from the refurbished or demolished inner spaces into the newly formed interior components structure, to accomplish an *intra-setting adaptive reuse* design concept [14].
- Reintroduction of post-consumer waste into the substance of constitutive interior components (e.g. space dividers as acoustic and visual buffers), as well as supplementing ones (e.g. furnishing, finishing layers) (see Figure 2).



Figure 2: Resource efficiency and waste management effectiveness sustainable design principles as a leading guideline for interior design components. Study on reuse of post-consumer waste. (Author: P. Krzanowska; Supervisor: M. Celadyn; source: Archive of the Faculty of Interior Design, *Jan Matejko* Academy of Fine Arts, Kraków, Poland).

DISCUSSION

The design projects made by the students during the workshop and close-ended part of the questionnaire supplementing the study confirmed their understanding of the importance of reasonable use of resources. The final results of the design projects confirmed the students' interest in exploring design methods and techniques to fulfil this belief, as well as those related to problems of water and energy savings or providing occupants with interiors with high-quality parameters.

The students, in their responses to the descriptive section of the questionnaire identified the following issues as beneficial in resource consumption in interior design:

1. Evolution of sustainability-oriented design of the built environment.
2. Design guideline for formal and functional cohesiveness of developed projects.
3. Creative implementation of sustainability principles into interior design projects.
4. Overcoming uncertainties or misinterpretations concerning the position of the interior design discipline in reducing the negative impact of the built environment on the natural one.

As the students pointed out, their perception of the value of environmental contextualisation in the design of interiors evolved significantly through exploration of the resource-efficiency strategy in design projects prepared within joint workshops. They found recognition of the interrelationship of both settings as a fundamental factor for informed interior design. The students finally identified the adoption of the environmental perspective into the creation of interior components, as a relevant means of searching for innovative solutions for the contemporary design of interiors.

CONCLUSIONS

The subject of the study was the modification of the existing interior design teaching framework, based on the inclusion of joint workshops on design projects within the Building Construction compulsory course and the elective course on Environmentally Sustainable Architectural Design, delivered to the undergraduate students. The main objective of the

study was to develop a formula for learning to enable the integration of the Environmentally Sustainable Architectural Design facultative lecture course with other teaching courses, and thus to establish a connection between theoretical knowledge on sustainability and its practical application in design projects.

This particular joint workshop, oriented to the development of appropriate design methods for practical implementation of the resource-efficiency sustainability strategy into design projects was intended to become the supportive and innovative learning tool by which to achieve this objective. The results of the students' projects, as well as their reflections on the structure and programme of the workshop, included in the related questionnaire, confirmed the usefulness of incorporating this experimental project-based learning module into the existing interior design teaching framework, as well as its further interdisciplinary extension.

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BIOGRAPHY



Magdalena Celadyn graduated in 1986 with a Master's in architecture from Cracow University of Technology, Kraków, Poland. She gained professional experience working as a design assistant in architectural offices in Montreal, Canada, on conceptual and technical designs. These included newly conceived buildings, renovated public buildings and commercial interiors. She took part in several international architectural competitions presenting original concepts for the formal and functional integration of the built and natural environment. From the late 1990s until 2006, she continued her professional career as a partner in architectural offices in Kraków. As a qualified architect running her own practice from 2007, Dr Celadyn was involved in 20 architectural projects for housing estates and commercial interiors. Since 2013, she has been working at the Faculty of Interior Design at the *Jan Matejko* Academy of Fine Arts in Kraków, where she is responsible for running

courses on building construction, structures for undergraduate students, as well as modern techniques of completion of architectural interiors for postgraduate students. Since 2014, she has been additionally responsible for leading an elective course on Environmentally Sustainable Architectural Design. The results of Dr Celadyn's research on the design methods of creation of sustainable interior spaces were enclosed in her PhD dissertation, *Multi-criterial Evaluation in Sustainable Architectural Design of Office Interiors*, defended with honours at Gdańsk University of Technology, Gdańsk, Poland, in 2016, and subsequently in a scientific book, *Environmentally Sustainable Office Interiors* in 2017. At present she is an Adjunct Professor at the Chair of Science and Art in Design at the Faculty of Interior Design.