Innovative methods for supporting the environment in the education of landscape architects

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ABSTRACT: In the context of climate change and other environmental issues, many new concepts to support the environment are emerging in the scientific literature. Landscape architects are important in implementing these concepts for environments impacted by humans. Therefore, they should be prepared for this in their education. In this article, the authors discuss methods for supporting the environment in the teaching of landscape architecture in the Faculty of Architecture at Cracow University of Technology (FA-CUT), Kraków, Poland, within the Integrated Design Studio, which is a key educational model. A holistic model of education has been developed in response to the requirements of changing markets. The methods used at the FA-CUT could become an inspiration for other teaching institutions.

INTRODUCTION

The Integrated Design Studio (IDS) is a key concept and model for teaching landscape architecture in the Faculty of Architecture at Cracow University of Technology (FA-CUT), Kraków, Poland. This allows students to apply knowledge from many fields in their course projects. Every semester requires the preparation of a design - in earlier semesters of a landscape architecture site (e.g. a backyard garden, city square, public park, post-industrial site recycling, recultivation) - and in later semesters landscape planning is covered [1].

The teaching of landscape architecture at the FA-CUT was verified by two rounds of accreditation from the International Federation of Landscape Architects (IFLA) Europe for the years 2010-15 and 2015-20. This covered the previous single-cycle Master's studies and the current two-cycle system [1], which is comprised of seven semesters of Bachelor's studies and three semesters of Master's studies.

Since the start of teaching the course in 2000, the curriculum has been adapted to the needs of employers and the changes in the environment effected by landscape architects. The principle of teaching social communication and participatory methods in design was adopted and is at present an element of many tender procedures for public spaces. Other curriculum developments concerning computer-aided design (CAD) and geographic information systems (GIS) have allowed students to be better prepared for work in the profession [1].

Outlined in this article is the supplementation of existing teaching to include nature-based solutions (NbS) and other innovative methods for supporting the natural environment. Design projects and assignments include climate change, global warming and other environmental disasters [2]. This ensures the preparation of students to support biodiversity and the prosperity and well-being of humans. This informs the profession, both now and into the future. In this article, the authors consider the potential of NbS in course curricula.

INTEGRATED DESIGN MODEL AT THE CUT

The integrated design model at Cracow University of Technology provides well-grounded knowledge of a holistic approach to sustainable landscape architecture design.

During first-cycle studies, the Integrated Design Studio (IDS) includes more, and a greater variety of, modules than second-cycle studies. This is based on the need for students to gain specific design and engineering skills, such as in technical drafting and CAD tool use. The positive results of the present model of integrated design in construction engineering, concerning CAD, building construction, materials science and structural systems, was discussed by Kuc [3].

The second cycle of studies - Master's studies - covers landscape planning, including recultivation, spatial and regional planning, protection and conservation plans, with NbS required (Table 1).

Table 1: Syllabus for Integrated Design Studio - two-cycle studies.

Semester	Name of design	Theme of design
1st cycle - Bachelor's		
1	Integrated Design Studio - enclosure composition	Principles of composition
2	Integrated Design Studio - private enclosure garden	House garden, backyard kindergarten or school garden
3	Integrated Design Studio - public urban enclosure	Green square
4	Integrated Design Studio - restoration of historical gardens	Monastery, convent garden estate garden
5	Integrated Design Studio - public park	Urban, rural, local park
6	Integrated Design Studio - reclamation of post-industrial grounds	Open pits, quarries, sedimentation tanks, mine dumps, river renaturalisation
7	Diploma design - engineer's design	
2nd cycle - Master's		
1	Integrated Design Studio - layout in natural landscapes	Development of reservoir banks, recreation centres, tourist development
2	Integrated Design Studio - spatial planning - local plans	Fragments of cities, towns and villages with special emphasis on natural and landscape complexes, plus ecological arable land
2	Integrated Design Studio - spatial planning - protection plans	National, scenic, culture parks
3	Diploma design - Master's design	

The Integrated Design Studio models for the first and second cycle are presented in Figure 1 and Figure 2. The modules can be divided into four groups, which correspond to each aspect of landscape architecture. These are: the environment; engineering; socio-economic; and cultural.

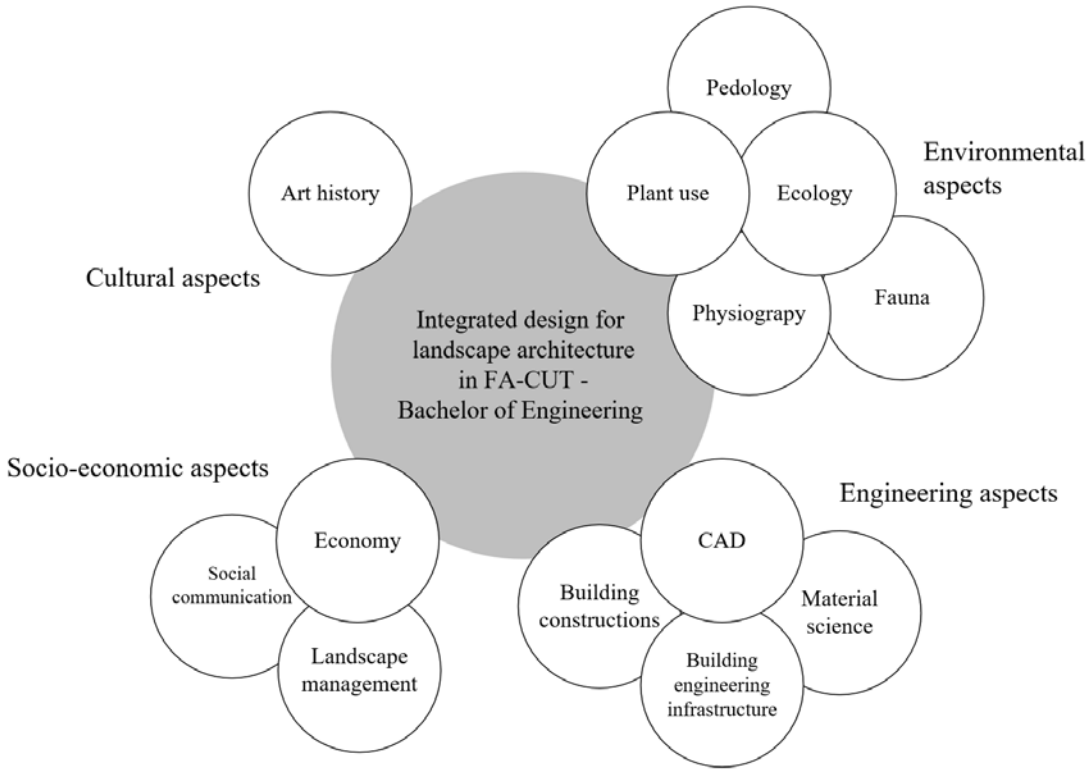

Figure 1: Integrated Design Studio - first-cycle studies.

Students at the FA-CUT have been taught landscape architecture with the integrated design approach, since 2000. Graduates have been successful in the profession, and in domestic and international design competitions. Graduates often

manage their own design studios or work in government institutions, e.g. Kraków institutions, such as the Municipal Greenery Authority or the Spatial Planning Bureau. Hence, this education model can be considered a success.

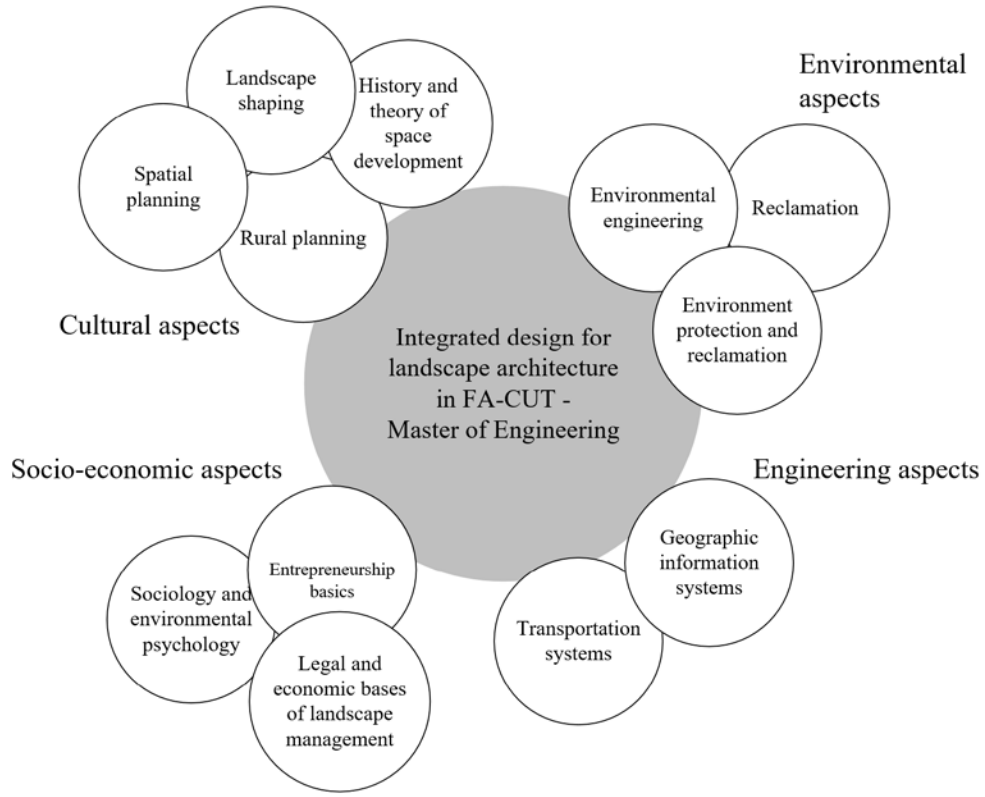

Figure 2: Integrated Design Studio - second-cycle studies.

However, the changing reality is not only of the professional market, but also of the natural environment on a global scale. This requires changes to the environmental standards set in teaching. Over the past 20 years, ecology and sustainable development have become increasingly important in landscape architecture. Ongoing climate change, the depletion of water supplies, flash floods and the need to limit CO_2 emissions (by 40% by 2030, following EU policies [4]), exert a considerable impact on landscape design, particularly in cities. A consequence is the trend to establish pro-environmental parks and the growing number of revitalisation, recultivation and recycling projects targeting decayed areas. These *solutions* are often associated with various innovative methods of supporting the natural environment (IMoSNE).

This subject matter has been present in the landscape architecture course since its inception, but at present is receiving more emphasis. The most important aspects of IMoSNE, their implementation in the FA-CUT curriculum and further proposals for modifying the Integrated Design Studio will be presented in the article.

THEORIES AND POLICIES FOR INNOVATIVE LANDSCAPE DESIGN

Damage to wildlife and the increasing threat to the environment have intensified academic studies. Theories, methods and action programmes intended to support and protect the natural environment include biodiversity, biophilia, ecological engineering, sustainable development, ecosystem services (ES), natural system agriculture, green infrastructure (GI), nature-based solutions (NbS) and ecosystem-based adaptation (EbA) [5][6]. These are intended to maintain the biological balance on Earth, and thus ensure human prosperity and well-being. They also highlight challenges for landscape architecture studies.

Innovative natural environment support methods and their application have been discussed at length in the literature [5-8]. Authors point to common and complementary features, e.g. NbS and ES or EbA and GI [7]. Differences have also been listed. Pauleit [8] believes ES is an abstract idea less oriented towards implementing and maintaining solutions than other methods [7], but can be used to develop urbanised areas with EbA and GI.

Regardless of their similarities or differences, all of these concepts have one common element: they are not based solely on technology, but utilise natural processes that take place in nature to a greater or lesser degree. Therefore, their use requires a proper understanding of the processes that take place in ecosystems.

In new parks established in post-industrial areas, existing synanthropic greenery is often maintained and facilitated by the ecosystem. Rain garden systems and forests are established in cities, regulating catchment hydrology, and soil and water pollution. The direction of contemporary landscape architecture is equally linked with both engineering, and the properties of plants and the ecology. Engineering remains an inseparable part of landscape architecture, particularly

solutions that counter climate change. However, there has been an increase in the significance of the natural sciences; students should be made aware of this.

The latest and broadest concept is NbS. Considered in this article is the solving of environmental problems using ES or other nature-inspired methods, but which also respect social, economic and cultural factors. The NbS differ from other innovative natural environment methods by using a holistic approach to problem-solving, analysing their diverse aspects in an interdisciplinary and multi-subject manner. This is implicit in the definition, by the European Commission, which describes NbS as a new umbrella concept [9] in support of biodiversity and ecosystem management to achieve sustainable development.

The NbS concept has environmental, social, economic and cultural aspects. It is the synergy of these seemingly different disciplines and practices that produce the added value of holistic nature-based solutions.

EXTENDING THE INTEGRATED DESIGN MODEL

The aim is teaching landscape architects using innovative methods that support the natural environment. The existing course has some overlaps with the ideal:

- The term, nature-based solutions (NbS), as a description of holistic solutions is in line with the concept of teaching based on integrated design.
- Assignments that students work on during the Integrated Design Studio, have many features of NbS.

Details of the current and proposed courses are presented in Table 2.

Table 2: NbS overlap between current and proposed courses for landscape architects.

<table>
<tr><th>NbS elements [6][9]</th><th>NbS elements in the current Integrated Design Studio</th><th>Modules that implement NbS in the proposed Integrated Design Studio</th></tr>
<tr><td>Environmental aspects:
• Increasing biodiversity
• Ecosystem management
• Restoration of decayed ecosystems
• Addressing critical environmental problems
• Energy and resource conservation</td><td>• Pre-design wildlife (plants) and natural analysis that account for noise or pollution
• Accounting for the existing natural habitat in designs (natural identity)
• Obligatory wildlife consultations
• Design of various forms of greenery, e.g. green roofs, street greenery and green space systems
• Blue-green infrastructure planning across different scales</td><td rowspan="3">First cycle:
• Building construction
• Structural systems
• Plant cover
• Plant ecophysiology
• Physiography
• Ecology and fauna
• CAD and 3D modelling
• Surveying and cartography
• Public participation

Second cycle:
• GIS
• Environmental engineering
• Environmental protection and reclamation
• Legal and economic fundamentals of landscape management
• Sociology and environmental psychology.
Public communication</td></tr>
<tr><td>Social and economic aspects:
• Social engagement
• Law and governance
• Local determinants
• Improving prosperity and well-being
• Simplifying application
• Cost minimisation
• Creating new employment</td><td>• Co-operation with external entities - municipalities and institutions, as organs which commission designs, thereby allowing students to indirectly participate in design
• Conducting surveys (for selected designs, e.g. public parks) and selected diploma projects
• Encouraging students to perform public consultations - through surveys and interviews during pre-design studies or field surveys.</td></tr>
<tr><td>Cultural aspects:
• Creating new places for rest and recreation
• Symbolic value of sites</td><td>• Pre-design cultural analyses - conservation-oriented
• Pre-design scenery analyses
• Steering attention towards the genius loci</td></tr>
<tr><td colspan="3">↓
Interdisciplinarity
↓
Holistic approach to design
↓
Applying nature-based solutions</td></tr>
</table>

Below are examples of student assignments from the Integrated Design Studio applying nature-based solutions. During the third semester of first-cycle studies, students analyse a city square and street, addressing:

1) storm water reuse;
2) using renewable energy, i.e. photovoltaic panels and the charging of electronic devices and vehicles;
3) combating smog;
4) low-energy lighting to counter light pollution.

Students selected one of these for their project.

During the second semester of Master's studies, students prepare a draft of a local zoning plan, both graphical and written. The subject is optional and may include urbanised and naturally valuable open space. The draft plan is required to account for landscape and compositional aspects, and the needs of various stakeholders and space users. Particular attention must be paid to greenery design, while recognising road cross-sections and road strips, and plant species and forms. It offers opportunities for applying pro-environmental solutions supported by tutors. Students attempt to convince municipal authorities of their visions during defences that take place at the end of the module. This confronts students with how the 'client' perceives the economic and social determinants, and often leads to interesting discussions. One example is illustrated by a local zone plan in Figure 3.

Figure 3: Local zoning plan prepared during the Integrated Design Studio, second semester, second cycle (Authors: A. Kosior and R. Pilarz, 2019).

This plan involved a pro-environmental solution that dampened the noise emitted by an expressway (green tunnel) and a nearby airport (park with tall earth forms, inspired by the acoustic solutions at Schiphol Airport in Amsterdam).

The Integrated Design Studio curriculum emphasises greenery design including green infrastructure and improving the urban environment via street trees; bioswales; roof gardens; green walls; domestic plants; green space accessibility; blue-green infrastructure planning; and the recreational and cultural value of green spaces.

The existing training of landscape architects at the FA-CUT supports innovative methods of protecting the natural environment through nature-based solutions. However, there is a challenge of augmenting this for students in their future careers.

A broader linkage of the IDS with NbS is planned by the FA-CUT including:

- the impact of biodiversity on the design;
- self-maintenance of ecosystems;
- ecosystem transformation;
- energy and resource conservation, e.g. recycling, water purification, governance.

A separate module of innovative methods supporting the natural environment has been investigated, as well as increasing the number of specialist diploma consultation contact hours, with a focus on wildlife and the environment. Since 2020, the authors have been focusing on public park design in the face of the COVID-19 pandemic, associated with maintaining social distancing.

Knowledge of ecology will allow students to address the long-term consequences of their designs.

CONCLUSIONS

Training landscape architects to implement innovative methods to support the natural environment is a necessity. The effects of climate change, expected by scientists, will have serious consequences. Therefore, swift action in education is necessary. Future landscape architects must be aware of the necessity of applying nature-based solutions across various scales, from a rain garden or green roof to landscape planning, sustainable urbanism and restoration of degraded ecosystems. Hence, the education of landscape architects is critical. At the FA-CUT, this has been made possible by the Integrated Design Studio, which, after successive changes to the curriculum, is a method that prepares students for designs to enable protection of biodiversity or adaptation to climate change.

Graduates perform as designers who are aware of the consequences of their design decisions in the long term and for future generations. The model described in this article can inspire other universities and courses. Teaching as many people as possible to apply innovative methods to protect the natural environment can be of key significance in preventing harmful changes that threaten human survival.

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