Architectural education in the formation of the built environment with sustainable features

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ABSTRACT: Architectural education plays a major role in shaping the built environment and in promoting sustainable development. It is considered a crucial element of high quality education and for accomplishing sustainable development. It is vital when considering the problem of city structure dispersion, popularisation of pro-environmental solutions in architecture and urban planning. This was confirmed by the results of a study aimed at providing an answer to the following research question: what is the significance of architectural engineering education in the formation of the built environment (residential and public), taking sustainable features into account? The results of the study, with an analysis of in-depth interviews of architecture students (Kielce University of Technology in Kielce, Poland), are encouraging and inspiring. They are presented and discussed in this article.

INTRODUCTION

The beginning of the 21st Century brought a rapid development of civilisation development, but also threats to the Earth's environment, which impacts on the formation of city structures in urbanised spaces. Hence, sustainable development of the built environment has become a serious issue for modern higher education. Education for sustainable development (ESD) is the key tool for achieving the goals of sustainable development [1-4]. Inclusion of environmental problems in architectural education has become an important research subject. Interdisciplinary education has become the basis for efficient teaching [5].

Architecture students, as future architects, urban planners and planners, will have a positive impact on society, the environment and sustainable development in architecture and urban planning [6][7]. The significance of architectural engineering and urban planning education has been growing, as reflected in the transformations made in the modern structure of cities. Of vital importance is teaching related to the formation of modern urban structures, focused on the implementation of the concepts of a socially, spatially, economically and environmentally cohesive city. The social dimension centres on participation and socially sensitive projects; the environmental dimension focuses on environmental protection; the economic dimension takes into account selection of locations and spatial planning.

Purpose and Scope

Discussed in the article are the results of studies carried out between 2017 and 2019 at Kielce University of Technology (Poland), aimed at offering an answer to the research question: what is the relevance of architectural engineering education to the formation of the built environment with sustainable features? The author's research was carried out on the basis of analysis of archives of student projects, observation and interviews with students.

ARCHITECTURAL EDUCATION: EXPERIMENTS AND ACCOMPLISHMENTS

Architectural and urban planning education is broad and multi-layered, which has been described from various perspectives:

- psychology in architectural design [8];
- green economy vs development of eco-architecture [9];
- eco-city principles [10];
- climate change challenges in architecture [11];
- respect for architectural heritage [12];
- efficient tools in architects' work (sketch, architectural drawing) [13][14].

The research subject tackled by the author is the significance of architectural engineering education in the formation of the built environment with sustainable features.

Architectural education involves the transfer of comprehensive knowledge about sustainable architecture and urban planning design, ecology and the promulgation of best solutions and practices. It has a vital impact on the quality of the built environment, which is strongly bound to the location and inextricably linked to the surrounding environment [15]. It educates the future architect and urban planner with a social approach to creating urban and non-urban space, both urbanised and natural. Paying attention to solving the most urgent challenges of the built environment is of primary importance. Combining scientific and research experience is particularly important in education as this is the path to deeper knowledge [16].

Staff at Kielce University of Technology, Kielce, Poland, experiment with projects and are open to activities within the scope of sustainable development. Innovative and an integrated educational approach promotes interdisciplinary thinking and critical reflection [17]. The Chair of Architecture and Urban Planning has played the leading role in developing students' knowledge of sustainability of the built environment. Of vital importance is city structure dispersion, the promotion of pro-environmental solutions in architecture and urban planning. Therefore, sustainable architecture in the city and outside has gained special importance.

The research methods included:

- Analysis of students' engineering diploma projects rewarded in competitions. Student projects are the result of completing an important stage of education at first cycle studies. Competition accomplishments testify to the high quality of teaching and co-operation between teachers and students.

- In-depth interviews carried out with the students of the best diploma projects. This allows for assessing the effects of co-operation between students and academic teachers.

Interdisciplinary and creative thinking about the interactions between humans and the environment are necessary for achieving a sustainable future. Students became engaged in interdisciplinary co-operation and as part of the co-operation, knowledge from various areas was employed during preparation of the projects. Students were encouraged to embrace other disciplines for self-reflection and motivation. This forms a basis for a global effort aimed at achieving sustainability for the future environment.

Architectural education requires multi-stage classes. Students started with extensive analyses of existing urban structures and their natural context, their own observations and field studies, applying study-based learning. Students had an opportunity to organise discussions and to learn from one another. They carried out surveys and in-depth interviews with managers of facilities, institutions and the local community to learn about the needs of future users of the designed establishments. They completed detailed consultations with representatives of companies to fulfil the ecological, economic and energy-efficiency requirements.

The scope of diploma projects, distinguished in recent years, shows the significance of architectural education and positive changes in European architectural schools. Students used the existing limited resources of the environment and space. They shaped and organised the space without being indifferent to its natural values, to the open and cultural landscape. In the majority of cases, the projects refer to experiments and searches in the area of shaping the architectural and urban planning form in relation to the natural environment: land, water and greenery - in harmony with nature and in a relationship to the jointly used space, i.e. social and public one.

Attaching great significance to the co-existence of architecture and nature has become vital in shaping sustainable built environments. Analysis of two diploma projects was carried out to illustrate the above and the results, as well as the impact of learning on the final outcomes (see Figure 1 and Figure 2).

The first example is a project for the replacement of urban unused and underinvested space with a green entertainment area, fully integrated with nature. The huge spatial facility that was designed is called *Green Velo Point* Biker's Service Point in Kielce and is a place of regional identification and a section of the national bicycle trail, *Green Velo*.

Architectural and urban planning solutions that integrate architecture and nature, the needs of tourists and residents, have priority. The architecture of the facility was sculpted in natural material, inspired by the surrounding landscape. The form gently cuts into the area and merges with the natural surroundings of the neighbouring reservoir. Designing urban tissue started with thinking about humans and the environment.

The project uses state-of-the-art technical solutions and applies products that are friendly for people and the environment. In effect, the space constitutes a universal modern built environment, fostering an active lifestyle for the entire community of the 21st Century. Extensive functional and utility programmes were designed based on broad spatial analyses and conclusions from surveys carried out among more than 140 users of the bicycle trail, and responded to the needs of its users (Figure 1).

Figure 1: Student Małgorzata Kałuża, *Green Velo Point*, Kielce (Poland). Main prize in the competition for the best diploma project in 2017 organised by the Kielce Technological Park specialising in development of new technology. It qualified for participation in the last stages of the prestigious international architectural competition, *LafargeHolcim Awards*, 2017, organiser: LafargeHolcim Foundation for Sustainable Construction; distinction of the examination committee/engineering diploma, 2017.

Figure 2: Student Mikołaj Wieczorek, *Jaskinia Raj* (the Paradise Cave), Chęciny near Kielce (Poland). Distinction in the competition for the best diploma project in 2017, organised by the Kielce Technological Park; distinction of the examination committee/engineering diploma, 2017.

The second project combines a single space that unites architecture and landscape, modernity and history with minimal interference to the existing assets of the natural landscape. An exhibition and scientific facility was set up in the middle of the forest, surrounded by the exceptional assets of the *Raj Cave* nature reserve within the range of the Świętokrzyskie

Mountains (Chęciny near Kielce). In a place of exceptional historical significance, next to one of the most beautiful caves in Poland (1963), a new pavilion was located, which responds to the modern needs of tourists and forms a place to deepen knowledge in the area of geology, archaeology and palaeontology. The original form merges with the natural forest landscape and the existing lay of the land, on account of which it does not dominate over nature but unites it. The green roof was treated as an extension of the landscape - the *Malik* hill - and creates a joint composition with the surrounding nature. The transparent façade dematerialises the architecture and creates a smooth and see-through space, which magnifies the experience of the natural environment (Figure 2).

Summing up, in the examples presented above, pluralist and action-oriented teaching for a sustainable built environment increases students' competence and zeal to act. The results show that student projects are distinguished by the highest values in all major dimensions on which the approach to sustainable development relies, i.e. social, environmental, economic and the impact of these on one another [18]. Architectural education teaches the ability to notice and to creatively react to the conditions of a location, the needs of a community and primarily demonstrates the conscious formation of space. Thus, such projects may constitute a significant determinant for the impact of architectural education on the formation of the sustainable built environment. The definition of the term *built environment* (in the context of the image of a city) is illustrated in the outline below, where key words are assigned to items (see Figure 3).

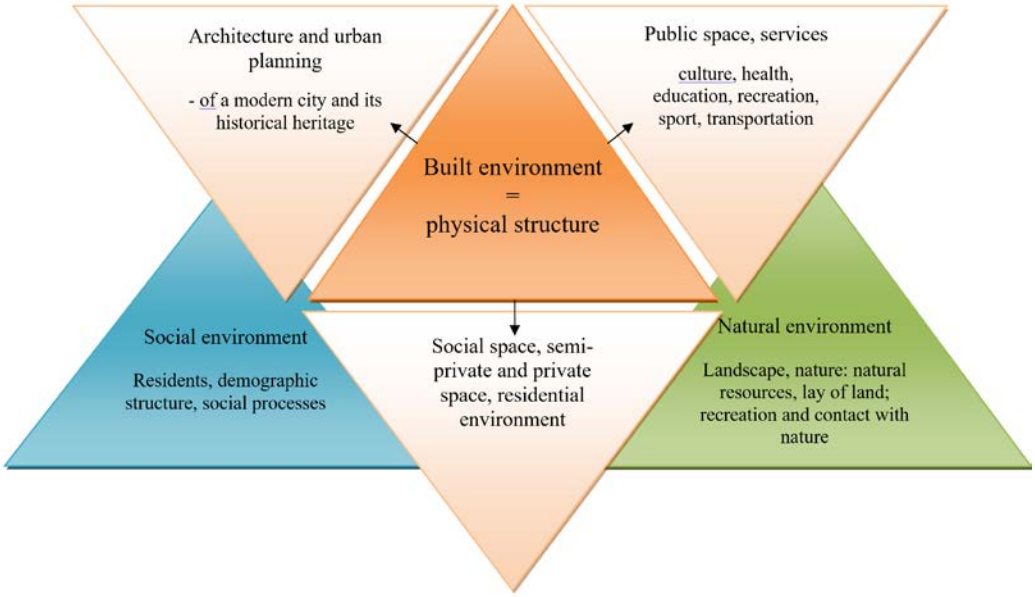

Figure 3: Factors making up the image of a city, including sustainable physical structures of the built environment. Compilation by the Author, 2017 to 2019.

PERSONAL INTERVIEWS: ANALYSIS OF PROGRESS AND BENEFITS GAINED

To learn more about the students' experiences and to determine the significance of architectural education in their development, in-depth interviews were carried out with the authors of the best diploma projects (67 students, 2017 to 2019). Every interview lasted about 60 minutes. The interview schedule included structured and open research questions aimed at identifying and examining the students' attitudes, and their approach to sustainable development in architecture and urban planning. The results of the assessment were encouraging and inspiring.

The survey included the following questions:

a) Which model of teaching was the most valuable for the students and what did they appreciate the most in the course of studies?
b) How do the students perceive and assess their skills and how has their level of awareness changed within the scope of sustainable development and implementation of its primary principles in architectural and urban planning?
c) Will the acquired skills and experience be extended and used at subsequent stages of education and in the future, outside of the University?

Analysis of individual discussions allowed for an in-depth examination of results. The collected data were divided into three thematic groups, focusing on education and transformation of students' competence. In reference to individual thematic groups, the conclusions below were drawn:

1) All persons participating in the study decided that the most important matters in education were: ongoing bilateral co-operation based on the teacher-student model and extended design workshops with interdisciplinary co-operation.

In reference to issue a) above, students particularly valued joint learning with the teacher, and especially *assistance in stimulation and facilitation of analyses* and *recognising reality in its rebuilding.* Equally important for the students was *encouraging them to problematise the environment, facilitating the process of searching* and *supplying information necessary to accelerate the design process*. This was conducive for solidarity, co-operation, creativity and reflection, dialogue and discussion. In this model, the following aspects also turned out to be important for students: *ongoing support and development of skills, assistance in combining facts and preparation of a synthesis of ideas, support in drawing important conclusions* and *understanding consequences.*

In reference to point b), it was concluded that by extended design workshops also encompassing other disciplines, such as social sciences, economy, ecology and health, students acquired broad project competence.

Interdisciplinary co-operation of students at the University has turned out particularly important. It was noted that interdisciplinary education and education based on interdisciplinary co-operation has become a basis for teaching taking sustainable features into account [5].

2) The students felt the change in the thinking and approach to the issue of sustainable development could be attributed to the analysis of case studies. All respondents incorporated principles of sustainable development in the process of design taking into account the social dimension, efficient environmental protection and the use of natural resources. They claimed that the *ability to notice* and to *consciously react to the conditions of a location and the needs of a society teaches integrity of architecture and urban planning* in the formation of space. The results have also shown that the students, at the time they receive the title of architect engineer, assessed the experience they acquired with respect to design and interdisciplinary co-operation. They decided that it affected their engagement and the feeling of satisfaction with the teaching process.

   The respondents' praised the possibility of participating in various extended interdisciplinary project workshops. Furthermore, many students mentioned they were going to learn more about this subject, as interdisciplinary co-operation for architects was an integral part of their profession and practice. The interlocutors believed that education in sustainable development *must definitely go beyond knowledge and practice* and has to include extensive learning. All students interviewed claimed they could accomplish such goals by an ongoing process of self-improvement, *discovery and preparation of new solutions in architecture and urban planning.*

3) As may be concluded from personal interviews, the ambition of young designers is to promote and implement future solutions in architecture and urban planning, taking the sustainable features into account. All of them stated clearly that the process of design is integrated, therefore they were going to use the acquired knowledge during subsequent years of study. They also raised hopes for the development of such experience in their own practice and design careers, inextricably linked to the creation of the built environment.

Summing up, the highly satisfactory result shows that architectural education opens a prospect for a better future for the built environment. As stated in the research proposal, architectural education has exceptional significance when devoted to sustainable development and expansion of knowledge in key disciplines related to the creation of the built environment. Due to this, it is believed to be a crucial element of high-quality education and one of the means for achieving sustainable development.

CONCLUSIONS

The results of the study confirm that architectural education is building a new generation of architects, urban planners and researchers ready to accept new concepts, based on basic principles of sustainable development of the built environment. Made use of in the study were the diploma projects as one of the most important measures by which to analyse the significance of architectural education in creating sustainable built environments. The success of students' projects was analysed through thorough observations, feedback and comments of students about their awareness and significance of the acquired skills.

Most important aspects of education focused on action and interdisciplinary co-operation. Based on the study results, the most promising are changes which the participants experienced and mentioned in the interviews. It may be claimed that architectural education offers a hope for a better future for architecture and urban planning. It develops talents and a new approach in advancing key competencies.

The following conclusions were drawn from the results of the study:

- Academic-level education in the Architecture and Urban Planning discipline offers design education, which constitutes a great force in the formation of the built environment with sustainable features; it forms a fundamental and efficient mode for implementing a sustainable future for the built environment.
- Education relying on various models of teaching and focused on interdisciplinary co-operation affects individual development of students, makes them sensitive to the valuable natural assets and puts special emphasis on creative activities based on theory and practice, as there is no good theory without practice and no practice without theory.

- Social education and inspiration for local authorities focuses on the actual needs of a city or a region and subsequently their popularisation.
- Architectural education teaches the ability of independent thinking and develops creative and innovative thinking, which are the factors determining future success [19]. Students, as future designers of architecture and urban planners will have great impact on the building of stances and preferences of investors relating to the sustainable built environment.

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