EUROPEAN UNIVERSITY CURRICULA FOR ARCHITECTS TOWARDS INTEGRATED DESIGN FOR TACKLING GLOBAL CLIMATE CHANGE BEYOND 2020

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ABSTRACT

This paper addresses two main research problems: existing gaps and challenges in architectural education as well as possible actions that could be undertaken to improve the university curricula for architects. The aim of the paper is to:

1. Identify the gaps between

- European university curricula for architects
- Actual environmental policies at global and European level and
- EU Research, Innovation and Development Programmes.

2. Provide suggestions for necessary changes in European university curricula in purpose to prepare the future generations of architects to lead and control integrated design processes towards tackling global climate change beyond 2020.

The author presents the results of current situation analysis, completed with the survey among architects, academic teachers and students of architecture from three EU countries. On the basis of these results suggestions concerning proposed changes in the academic education for architects are put forward. These recommendations are oriented towards integrated design for tackling global climate change beyond 2020.

Keywords: *education, innovation, sustainable architecture, energy efficiency, climate change.*

INTRODUCTION

In the light of changing policies towards the environment, and especially the implementation of the Paris Protocol, the need for integration of approaches to holistic environmental design will arise [4]. Within next 10 years architects, civil engineers, environmental engineers and the whole building industry will experience a green revolution. Architects, as multidisciplinary team leaders, would have to coordinate various complex processes directly linked to EU and global policy demands regarding: sustainable development, energy savings and renewable energy production in buildings, high performance in terms of energy efficiency, integrated heating and cooling systems, consumers engagement (including e.g. post occupancy evaluation), reduction of GHG emissions, etc. [3]. Actual education and university curricula do not fully prepare architects and engineers to provide adequate response to these demands. While there is a lot of commercial firms on the market that

promise low-carbon, energy efficient and environmentally safe buildings, in reality most of them involve so called false green declarations. And the expectations in the next decade will grow dramatically. This will require changes in university curricula for architects, intended to enable them to lead and control interdisciplinary design processes in multi-branches teams.

CURRENT SITUATION ANALYSIS

One of the most important challenges for European universities in perspective of next few years, i.e. 2020 and beyond, should be to provide education, training and skills to these professionals who can lead towards change, at the global level. When we look at European leadership in general, probably one of the strongest potentials can be seen in human resources. Distinguishing feature of Europe is putting a lot of stress on individual approach and respect for subjective needs, also in the field of education and personal development. That brings such results as very well educated individuals who can lead instead of 'following procedures', what is more typical for corporation approach worldwide. That refers in particular to so called 'liberal professions', including architects, who very often remain underestimated when talking about EU Leadership.

The analysis of European universities curricula for architects, completed with the survey among architects, academic teachers and students of architecture from three EU countries (UK, Italy, Poland), carried out in 2016, revealed the strengths and weaknesses of actual education systems.

Some of the most important identified strengths were:

- Understanding the importance of cultural heritage preservation and conservation;
- Ability to design the new built environment in the context of cultural environment;
- Strong focus on functional and economic aspects of the building;
- Good understanding of the contemporary user needs, high level of user comfort;
- Growing interest in sustainable design;
- Popularity of various software dedicated for architectural design, relatively easy access to adequate hardware and selected key enabling technologies (KET), such as e.g. 3-D printers;
- Working on advanced building models, including programs for structural system design.

The most serious identified weaknesses were:

- Very common lack of understanding of passive and active environmental strategies;
- Low level of understanding of climate change impacts on the built environment and ecosystems;
- Problems with practical application of bioclimatic design;

- Difficulties to address the issue of deep renovation of the existing buildings oriented towards high energy efficiency;
- Few programs preparing students for advanced design such as e.g. adaptive building skin design;
- Very few proposals for end-user engagement in design and post occupancy processes;
- Almost complete lack of information about circular economy models;
- Lack of effective cooperation between different fields of specialization which results with the lack of ability to manage integrated design processes.

DISCUSSION OF RESULTS

For the last 2 decades we have been experiencing very narrow specializations. That could be positive but too much of fragmentation is related to the risk of losing a wider image. Especially leaders, such as architects, that are responsible for the work of groups of people, need to have more knowledge, more tools and also more flexibility. Today more integrated approach to architects education, including multi-branches design processes is absolutely necessary [1]. For example only multidisciplinary research allows for the real application of key enabling technologies and advanced materials. The ICT skills are necessary to coordinate and control various complex processes directly linked to EU and global policy (renewable energy, heating and cooling, energy efficiency in buildings, sustainable development, etc.) [5]. That refers to the role of an architect as a multidisciplinary team leader. Without knowledge, understanding and ability to use advanced software and IT tools architects, as well as environmental and civil engineers, would have to outsource the crucial tasks that determine the failure or success of the whole projects.

There is a necessity to create dedicated e-platforms that would, inter alia, facilitate the integration of sustainable environmental design in university curricula and in the practice of architecture, promote integrated education, knowledge exchange, on-line access to ICT tools such as software for sustainable design. A leading and outstanding example of such a platform was EU-funded Project EDUCATE (Environmental Design in University Curricula and Architectural Training in Europe), launched in 2009 [8].

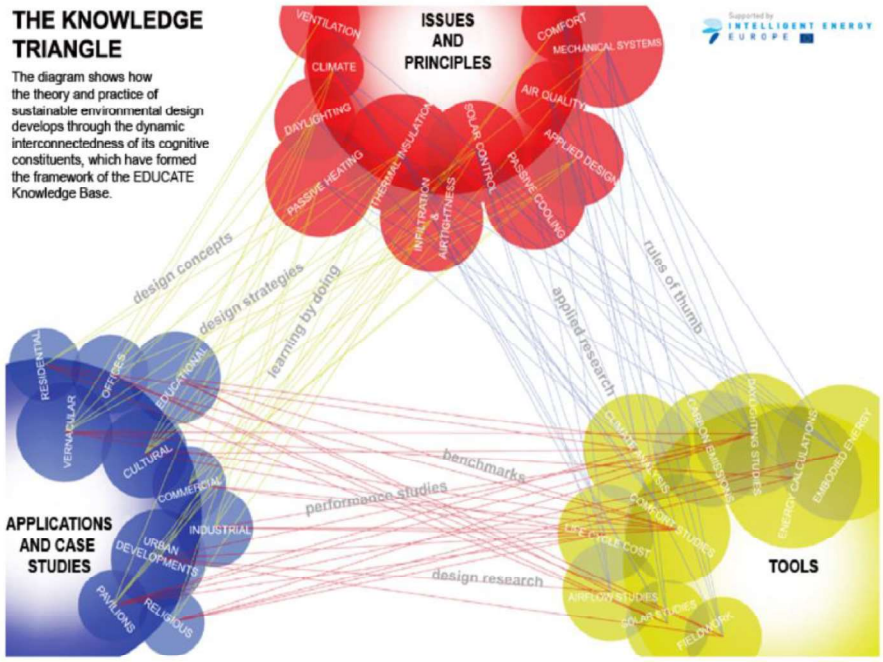

Fig. 6. An integrated cognitive framework proposed by EDUCATE, where the knowledge associated with sustainable environmental design can be systematised under: Issues and Principles, Applications and Case Studies, and Tools. Image source [2].

Connecting people is also crucial for integrated design processes, where the EU resources to support the initiatives would be very relevant for Growth as well as for R&D actions. European programmes concerning both leadership and e-leadership for liberal professions should support education and development of architects as an important group of EU leaders. It concerns also a wide team of environmental engineers: specialists in heating, cooling and ventilation technologies, water cycle in building, water harvesting and treatment, energy production, storage and transmission, including all the green technologies, renewable sources, recycling, embodied energy, Life Cycle Assessment, green transportation, etc.

In the next few years the key technologies which have driven innovation, such as mobile devices or cloud computing, will combine with other emerging trends, like Internet of Things (IoT), virtual/augmented reality, wearables, 3D printing, cognitive systems and robotics [7]. This could be complemented with micro and nano electronics, nanotechnologies, industrial biotechnology, photonics and advanced materials manufacturing technologies. It is very important to link the most up-to-date works from the field of research and development to their practical applications. The same is truth at the level of educational practice and university curricula. The fear and anxiety for emerging and cutting edge technologies could be easily mitigated if this knowledge is translated from the level of mysterious theory to immediate practical understanding. Some fantastic examples could be

observed when scientists work with children. As the youngest generation is usually free of prejudice in terms of advanced science, the knowledge is absorbed intuitively.

Thus, instead of keeping KET as separate area, accessible for the chosen ones, we should use them as tools in teaching, and especially in university practice. It is recommended to promote the innovative initiatives and educational programs directed towards embedding practical application of Key Enabling Technologies (KETs) in university curricula. The example of such KETs application for the architects professional education is the ability to design in 3D environment, with digital tools enabling advanced parametric design. Parametric design should be understood as process based on algorithmic thinking that allows for the expression of parameters and rules defining the relationship between design intention and response [6], [10]. Particularly valuable and worth supporting initiatives are the newly created educational strategies combining the most actual challenges for society such as climate change and energy with built environment design [9]. The specific example is the design and modelling of geometry to develop performative, interactive architectural and structural concepts while following the necessity of highly energy-efficient building skins.

Further examples related to KET application in education of architects involve:

- Architectural design in virtual/augmented reality combined with usage of wearables e.g. to demonstrate to the client the characteristics of newly created space;
- 3D printing for architectural applications;
- Advanced digital tools for integrated design processes for built environment, including the analysis of the environmental impacts of materials and buildings (with LCA method), and especially the impacts related to climate change;
- Introduction of cognitive systems in buildings;
- Phase change materials and nanomaterials applied for advanced insulation systems;
- Micro-CHP (micro combined heat and power) for buildings.

The list could be much longer. The given examples illustrate how KETs could be directly applied to the educational practice and this way contribute to at least two important purposes:

- Education of future EU leaders at the global level of innovativeness;
- Further improvement of EU high-tech skills, knowledge and consequently also the increased technological efficiency.

This could be perceived as the EU added value and an innovative example of ‘circular economy thinking’ at the level of technology-knowledge-skills loop.

CONCLUSIONS

The author of the paper carried out the analysis of current situation regarding European university curricula for architects, completed with the survey among

architects, academic teachers and students of architecture from three EU countries. On the basis of the results of this analysis, suggestions concerning proposed changes in the academic education for architects were put forward. Proposed actions for improved university curricula for architects involve:

1. Necessity to develop more integrated approach to architects education including the ability to lead multi-branches design processes.
2. Stronger stress on understanding of climate change impacts on the built environment and ecosystems, including bioclimatic design.
3. Introduction of strategies for circular economy models and low emission zones.
4. Embedding practical application of Key Enabling Technologies (KETs) in university curricula, e.g. the ability to design in 3D environment, with digital tools enabling advanced parametric design for adaptive building skins etc.
5. Better practice in use of advanced digital tools for integrated design processes for built environment, including the analysis of the environmental impacts of materials and buildings (with LCA method), and especially the impacts related to climate change.
6. Structural and energetic modelling for high energy efficiency in buildings, including deep renovation of existing buildings with respect to the cultural environment.
7. Effective end-user engagement in design and post occupancy processes.

Architects education should be perceived in categories of shaping future EU leaders at the global level of innovativeness as well as an improvement of EU high-tech skills, knowledge and technological efficiency.

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