

Role of research in architectural education at FA-STU

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ABSTRACT: Discussed in this article is the role of research in architecture, which is a discipline and field of knowledge. It highlights the optimal career development for researchers, describes the basic assumptions for conducting research and provides some examples on how to incorporate the methods and tools gained from basic/applied research into architectural education. This includes virtual reality headsets for designing, physical models of historical buildings, and for understanding the compositional and constructional principles of design, etc. Another way to deal with research in education is through the involvement of students of all study programmes and doctoral students in specific research tasks. Presented in the article are various types of project from the Faculty of Architecture at Slovak University of Technology in Bratislava, Bratislava, Slovakia, such as national/international funding, research tasks commissioned by the state or enterprises, or design-build projects which are highly popular with students. Included are research and teaching methods along with examples of several student outcomes.

INTRODUCTION

Universities around the world promote and support independent and critical thinking. But they are also the *factories* of education the quality of which is distinguished and characterised by various performance indicators. These indicators include number of students, teachers and researchers, research projects and funding, co-operation with foreign institutions, number of high quality publications and employment of graduates. Such academic achievements reflect a *university's spirit*, which is relevant for the wider public and foreign partners. In addition to education, research represents one of the key tasks of these institutions. Scientific findings and specific methods can be beneficial for the public or business sector, but they also should be incorporated into the teaching process. Carrying out the research is closely linked to the human, financial, technical and technological capital of the institution.

RESEARCH BACKGROUND

In general, academic staff have to carry out research and participate in research projects that usually are motivated by a *libido sciendi* followed by *extra money*. It is an uncompromising competitive struggle in which the quality of results, their applicability in practice and providing a solution to current societal challenges are decisive factors in obtaining finances for research. Financial resources come mainly from national or international funding or the industrial sector. The question remains whether this financial dependency of universities on external parties still satisfies the characteristic of *freedom of research*. *Ergo*, some researchers hold an opinion that this freedom is being more and more constrained.

It is well known that this system occasionally results in a predominance of quantity over quality, mainly regarding the publication output. The Web site *nature.com* reports that China was declared the world's largest producer of scientific articles. Chinese researchers published more than 426,000 studies in 2016 or 18.6% of the total documented in Elsevier's Scopus database. That compares with nearly 409,000 by the United States. It states, as well, that the United States spent the most on research and development, about US\$500 billion in 2015 or 26% of the global total. China came in second, at roughly US\$400 billion [1]. In 2018, according to the Slovak national budget report, Slovakia spent around US\$374 million on various types of research [2].

Nowadays, universities must balance freedom of research with financial support. This is a global trend but are there other possibilities? The commercialisation of intellectual property and promotion of promising innovative technologies with commercial use represent a crucial role for an academic research strategy. As an inspiration, the authors of this article report some specific determinations within a general research policy set by the special Commission for Politics on Research of the Faculty of Architecture and Urbanism of the Central University of Venezuela [3]:

- parallel to the projects within national priorities, it is necessary to consider aspects of architectural education giving special priority to those research projects related directly to the improvement of education for architects and planners;
- scientific research is an important key for the development of teaching processes ... through works, publications, etc, it will not only contribute to postgraduate teaching but will, as well, be a generator and promoter of new teaching methods in architecture;
- ...research projects should be based on a) lecturers, individually or with other bodies, they must prepare research programmes yearly; b) priority areas should be defined even if they are momentarily out of the immediate need of teaching activities; c) preferably research should be performed in groups, because generally its impact will be far broader and a better use of resources will be realised [3].

The Faculty of Architecture at Slovak University of Technology in Bratislava (FA-STU) has a strategy on research which respects EU priorities. The national strategy is titled: *Through knowledge towards prosperity - research and innovation strategy for smart specialisation of the Slovak Republic (RIS3 SK)*. There is the STU's strategy for financially supporting specific fields of research [4]. Other determinants include the priority for various types of funding or societal challenges that need to be solved while respecting the requirement for transferability of all outputs in the practice or education process [5].

Another crucial document from the FA-STU is the *Long-term plan for the STU development for years after 2018*. One of the declared strategic aims is the engagement of all students in scientific research and creative work, and the publication of scientific results [6]. In general, architectural research is quite specific and according to the European Association for Architectural Education (EAAE) it is characterised by:

...an original investigation undertaken in order to generate knowledge insights and understanding based on competencies, methods and tools proper to the discipline of architecture which has its own particular knowledge base, mode, scope, tactics and strategies [7].

Presented in this article are the ways FA-STU students are involved in research on various types of project. They demonstrate the key element of scientific exploration participation in the process under the leadership of senior researchers. The research process can be divided into several steps, as follows (see Table 1):

Table 1: Steps in a typical research process and the degree of student involvement.

No.	Basic steps in the research process	Degree of student involvement		
		Bachelor's degree	Master's degree	PhD
1	Defining the research problem	low	medium	high
2	Conducting the literature review	medium	high	high
3	Formulating research aims, objectives and developing hypotheses	low	medium	high
4	Preparing the research design/development of instrumentation plan	low	low/medium	high
5	Selecting methods of data collection	low	low/medium	high
6	Data analysis	low	medium	high
7	Interpretation and report writing	low	medium	high

RESEARCH CAPACITIES AT FA-STU

To guarantee the quality of teaching in the era of higher education *massification* the time-consuming process of research with a high risk of failure is limited by the researcher's yearly capacity. This is standardised in Slovakia, from 1,000 to 2,000 hours per year varying with respect to the employee's qualification and academic position. The full capacity of a position is about 2,000 hours per year, which means that research takes up from 50 percent to 100 percent of professional obligations. An interdisciplinary approach and collaboration among various fields of research and study programmes is increasing and is very acceptable.

Science teaching starts at the university with the doctoral study programme. It usually represents the first contact for many students of architectural education with fundamental principles of how to carry out research. It provides knowledge about scientific integrity, tolerance, acceptance of differences and honesty regarding the participants in the research. Research at university basically includes students in the third cycle of education. Such young researchers are motivated, enthusiastic, open minded, thought provoking and under the auspices of senior researchers can foster research and teaching as well. A new generation of young researchers is usually not daunted by the high level of knowledge and can bring new insights on societal issues, sometimes resulting in innovative outcomes. Collaboration among various generations of researcher is the greatest advantage of research at a university. Shown in Table 2 are the academic staff at the FA-STU, their research capacity and number of students. A key element of research at the FA-STU are the full-time PhD students with nearly 45 percent participation rate in research.

Table 2: Academic staff at the FA-STU, research capacity and number of students (data from 31.10.2018).

Position	Degree/ qualification	Number	Research capacity (h/year/person)	Research capacity in total (h/year)	Participation percentage in research %
Students	Bachelor's degree	565	-	-	7.62
	Master's degree	275	-	-	16.23
In total		840	-	-	23.85
PhD students	PhD (full-time)	66	2,000	132,000	43.42
	PhD (part-time)	21	2,000	42,000	13.82
Academic staff	Assistant to professor	48	1,000	48,000	15.79
	Researcher	20	2,000	40,000	13.16
	Associate professor	29	1,000	29,000	9.54
	Professor	13	1,000	13,000	4.27
In total		197	-	304,000	100

The authors hold the opinion that the best way to continue a research career after obtaining a PhD is through the faculty and university *postdoc* position designed for the best students. It provides PhD graduates with an extra study programme enabling the progression of their dissertation thesis and involves them fully in the education process, where they can capitalise on their findings and experience. General criteria of originality, significance and rigour of architectural research are discussed at the *EAAE Research Academy*, a think-tank articulating and promoting common concerns and interest in architectural research and which is led by representatives of the EAAE. Slovak University of Technology, Faculty of Architecture is a fully-fledged member of this work group and participates in shaping and developing several architectural research paradigms and perspectives in Europe.

RESEARCH GROUPS AND CENTRES AT THE FA-STU

To conduct research at a high international level, it is important to be specialised with an interdisciplinary approach to research. The FA-STU operates 20 research groups with academic staff in nine institutes of the Faculty (see Table 3). Research and teaching are also supported by five research centres. One of these (Architectural Research Centre for Heritage and Art education in Banská Štiavnica - ARCHA) is a detached workplace outside the faculty, the main scope of which is devoted to specialised education of historical heritage restoration and terrain-related teaching, art workshops, exercises and studio sessions, as well as design workshops for lifelong learning (see Table 4) [8].

Table 3: FA-STU research groups. Group members teach and supervise PhD candidates.

FA-STU Research Groups	
Architecture, Culture and Sustainability	Construction Engineering and Management
Tradition and Innovation in Architecture/Materials	Cultural Heritage and Monument Restoration
Digital Technologies in Architecture and Urban Design	Theory and History of Architecture
Interior Spaces Design	Urban Law and Land Use Planning
Body Conscious Design	Urban Sustainability, Collective Spaces and Local Identities
Design for All	Automotive Industry
Public Buildings	Product Design and Prototyping and Design Education
New Housing Models	Graphic and Communication Design
Research by Design/Project and Practice	Natural Landscape
Elements in Modern Building Construction	Visual Art

Table 4: Research and teaching centres at FA-STU.

FA-STU Research and Teaching Centres	
A2020	Centre of Sustainable and Efficient Architecture - Architecture 2020
BCD Lab	Body Conscious Design Laboratory
CEDA	Centre of Design for All
ARCHA	Educational and Research Centre in Banská Štiavnica
CeKa	Centre of Landscape Architecture

In addition, the Centre of Sustainable and Efficient Architecture - Architecture 2020 (A2020) conducts research and training activities in the field of architectural design meeting the criteria of the Energy Performance of Buildings Directive 2010/31/EU for new constructions after 2020, with emphasis on sustainability and respect for the environment. The body conscious design laboratory (BCD Lab) is a research and educational centre providing specialised training and research in the field of design and architecture. It focuses on exploring human responses to the built environment and its elements, and on emerging conscious design choices [9].

The Centre of Design for All (CEDA) is dedicated to the principle of universal design, enabling people in Slovakia to integrate into a society that takes into account human differences and interact with their environment to the best of their abilities. This Centre educates students to be more empathetic in considering the diversity of users and involves them in various projects observing and evaluating selected university buildings from the position of users with disabilities [10]. The Centre of Landscape Architecture (CeKa) deals with landscape adaptation and its preservation.

APPLIED RESEARCH IN THE TEACHING PROCESS

The main pedagogy at the FA-STU is design. Studios divided by topics and led by research group members represent places where students encounter basic research steps for the first time. Investigation of the site relationships, proposals of the transformation strategy and design concepts or the evaluation of each project through diagrams and schemes are integral parts of the semester work. Expressing ideas through models and sketches or principles of *learning by doing* are actively used [11]. These methods predominately are applied in the field of architecture but they also are in design. A particular segment represents the field of monument restoration. Analytical methods, archive research, fieldwork and surveying are the fundamental tools to deal with issues of cultural heritage. This variety of technique helps to produce competent professionals.

Figure 1 shows a map of the oldest brick-wall buildings in Banská Štiavnica (first half of the 13th Century) and the floor plan of a basement with an old sewer system and street elevation. These drawings were elaborated by students of architecture and geodetics as part of research on building and urban development of the city.

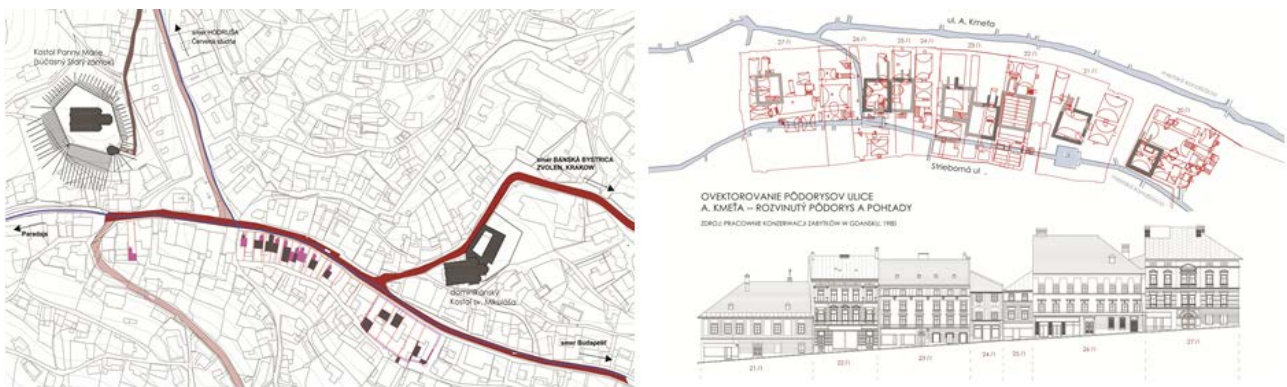


Figure 1: Above left is a map of the oldest brick-wall buildings in Banská Štiavnica. At right is a floor plan of the basement; the old sewer system; and street elevation.

CO-OPERATION WITH THE INDUSTRIAL SECTOR

The industrial sector represents an important partner of research centres and universities. The sector usually has good financial background and often can be labelled pioneers in research. Nevertheless, some of the specific research tasks are being commissioned with higher education institutions that have young researcher potential. The FA-STU has many partnerships with municipalities, companies or the automotive industry. These assignments involve both service-learning and applied research projects [12]. The Fit 2 Natural User Interface (NUI) was a research project carried out at the Institute of Design FA-STU in 2018 and was developed in co-operation with Škoda Design and Volkswagen's Future Research and Trend Transfer Department.



Figure 2: Above left is a personalised comfort zone by light and gesture (O. Dóci). Centre: a natural user interface adapted for relaxation (N. Földesová). Above right is an autism-friendly user interface (M. Reháková).

The main objective of the project was to design futuristic user interface concepts for autonomous driving beyond the year 2030. The concept of NUI refers to the user interface that is 100 percent comprehensible. Students of various degrees explored human-machine interface solutions for non-graphical interfaces. The results included interactive hardware prototypes and virtual reality simulations of interiors of cars in motion. Besides the focus on NUI research, the project included exploration of new car ownership models and integrated ideas for future brand distinction (see Figure 2) [13].

DESIGN-BUILD PROJECTS

A specific area of research relates to *design-build projects*. According to the EAAE, they can be regarded as research by design involving dealing with concrete issues in architecture. These projects mainly are performed at the FA-STU within the Work of Art in Architecture subject. The main scope is small designs with the aim to stun the visitors, to arouse interest while having some added value. It is not only about creating a piece of art, but it also explores the boundaries between installation and architecture. Students must think broadly, they must respect production proceedings and account for transport and time limitations. This represents an extension to architectural education at the FA-STU and is titled ephemeral architecture (EA). All designs are able to be dismantled and reinstalled in different places. All designs within the subject become part of an internal competition and only the best proposals are presented.

All students can be awarded European credit transfer system (ECTS) credits, but only the best proposals are realised. Later, there is the *how-to-make* process that is highly inspiring and is performed during the summer school project. Being voluntary, students grasp organisational, management and building skills. The theoretical part includes contemporary visual art and how to deal with design at the boundaries of installation, art and architecture. The main challenge is to foster groups and to motivate the losing teams to participate in the winning project. Failure and co-operation are the main aspects of research.

From the scientific point of view, students are investigating the features of various materials; dealing with many technical issues, proposing joints and pipe connections, and so on. Such design-build projects are most popular among students. Figure 3 shows a selection of student works elaborated within the subject, Work of Art in Architecture. These mainly are supported by the private sector and are designed and built by students of the Bachelor's degree of study at the FA-STU.

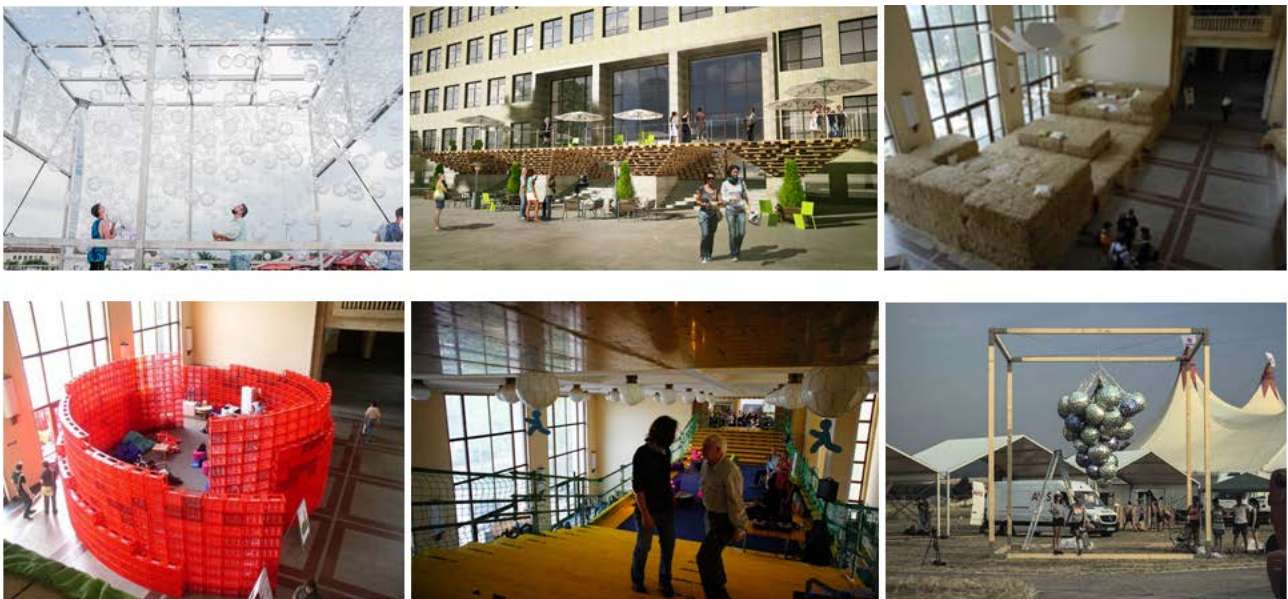


Figure 3: A selection of student works within the subject, Work of Art in Architecture supervised by Mr Bohuř Kubinský. Left to right (Top): *Shower pavilion* (1,700 transparent plastic balls); *1x1 pavilion* (4 pyramids made of wooden carrier's pallets); *Ecoliving* (30 tons of straw blocks as an illusion of living space). Left to right (Bottom): *Tea in crate* (pavilion made of 1,500 bottle crates); *fa:bridge* (connection between storey landings constructed of collapsible formwork); *GROZNO - under Grape* (installation at the music event GrapeFestival. It is made of unused CDs).

CONCLUSIONS

Research in architecture is very specific by its nature, compared to other fields. The FA-STU tries to support and develop students' creativity through various activities, and their involvement in different types of project. Having the aim to produce graduates for praxis, students must gain practical skills and think about the problem or problems, within a wider context. The study at the Faculty provides a space with tutor support, with the aim of being proactive and expressing student creativity. This results in interesting outcomes that can be branded artistic or scientific. Both types of

results assume research in the area of architectural thinking and foster ambitions to create a better space for people or a better type of design product.

Therefore, it is necessary to involve students of all degrees and study programmes and to encourage them to be identified with the mission of the Faculty. The joint objective is to prepare them for co-operation and networking. Through such activities they develop critical thinking, which is required to produce competent and professional research work. Therefore, they can keep the torch burning for future research and push forward the boundaries.

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