Effectiveness of universal design education in architectural design studios

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ABSTRACT: This article is focused on the evaluation of the implementation of elements of universal design in architectural design studio works in the Faculty of Architecture and Design at Slovak University of Technology in Bratislava (FAD-STU), Slovakia. The aim of the research is to assess the effectiveness of the transfer of theoretical knowledge from the compulsory subject Universal Design to the design studios, which represent the practical part of architectural education. Selected outputs of the design studios are compared with selected diploma theses - the capstone project in the FAD-STU. The research is based on the hypothesis that students develop, acquire and consolidate their knowledge attained in the subject Universal Design during their studies in the FAD-STU. It is, therefore, assumed that the outputs of their diploma theses will also be of higher quality in terms of the application of universal design than works from previous design studios. A summary of the findings regarding the aspects of universal design that have been successfully implemented into the design studios are followed by a set of recommended measures to improve the current situation.

Keywords: Universal design, architectural design studio

INTRODUCTION

The task of practising architects is not only to design aesthetic buildings that meet the current regulations and the client's demands, but also buildings that are sustainable and people-friendly. From this point of view, young architects must acquire contextual design thinking during their studies. As Czafík et al mentioned, architecture is a multidisciplinary field [1]. Contextual thinking, therefore, naturally focuses also on the social dimension of architecture [1].

One of the important aspects of sustainable design is universal design. In the Faculty of Architecture and Design at Slovak University of Technology in Bratislava (FAD-STU), Slovakia, students learn the principles of accessibility and universal design continuously, already from the first year of Bachelor's studies. Relevant basic information is obtained in the context of a specific type of buildings within the main subjects Typology I - III, which are focused on residential buildings and various public buildings. Subsequently, the universal design theory is implemented each semester in practical tasks within Design Studio I - VII, and of course, in Bachelor and diploma thesis (projects).

In addition to typologically oriented subjects, the fourth-year students also have a specific compulsory subject Universal Design. The aim is to deepen their acquired knowledge, stimulate their interest in universal design and support its implementation in practice as one of the priorities of teaching universal design is to form social feelings and positive attitudes of students towards inclusion and active aging [2].

This subject is taught in a way to motivate and attract students to this issue, not only to provide them with basic knowledge and skills. Therefore, every student is involved in empathic exercises, to simulate the movement and orientation of people with various disabilities or limitations, such as people in wheelchairs, people with visual impairments, older people with reduced mobility, etc. This experience helps them think about the design process more holistically, not only by implementing typology and legislation, but also by applying a human-centred approach.

Froyen views universal design as:

> ...an academic and professional research and design response to a democratic requirement for integral and inclusive accessibility based on a social concept. It is a double concept, in which (1) universal refers to human diversity and to a radical human-oriented approach (user-centred), and (2) design appeals for extremely creative and qualitative design solutions founded on empirical investigation (evidence-based) [3].

Leurs et al [4] and Kouprie and Sleeswijk Visser [5] highlight several factors, which are important for the development of a human-centred approach in architectural design education:

(1)   design project tasks should be authentic and as realistic as possible, (2) students should conduct the research (observations, interviews, field study, scenarios, etc.) and get the real users involved in their design process, (3) students should immerse themselves into the users´ experience to achieve empathy and understanding different users´ needs [5].

Therefore, it is necessary to link the theoretical and practical tasks in architectural design education with real tasks and experiences. Without sufficient knowledge of the needs of people with physical and cognitive limitations, architects are not able to design an inclusive built environment [6][7].

RESEARCH GOALS

The research aims to assess the effectiveness of the transfer of acquired theoretical knowledge about universal design into the architectural design studio work, which represents the practical part of the education. To verify the extent to which the students have mastered the acquired theoretical knowledge, two methods are used: 1) questionnaire; and 2) qualitative evaluation and comparison of the outputs of student works following universal design according to the evaluation checklist (Table 1).

Table 1: Example from the first part of the evaluation checklist - part A: accessibility of public space.

Assessment of the accessibility aspect in students' projects of public buildings by the UN Convention on the Rights of Persons with Disabilities and Slovak Building Law - Decree No. 532/2002					
Project/student: Sci-fi Centre/K.K.		Semester:10		Project score in percentage: 85	
A	Accessibility of public space	Y	P	N	IR	
A.1	Is building accessible by public transport?	x				
A.2	Is public transport in walking distance (400 m)?	x				
A.3	Is the area around the building accessible without barriers?	x				□ accessible crossings for pedestrians □ accessible sidewalks □ ramp
A.4	Is there an orientation system for people with visual impairment?		x			□ guiding lines without obstacles □ a signal strip leading to the entrance
A.5	Are there designated parking spaces for people with disabilities?	x				□ 4% of the total number □ 3.5 m x 5 m □ near the entrance, with an accessible route

The research is based on the hypothesis that students continuously develop, acquire and consolidate their knowledge about universal design during their studies. At the beginning, for students who have very limited experience, it is still almost impossible to create adequate and robust designs with a potential of feasibility based on just theoretical knowledge [8]. Thus, it is assumed that the answers of Master's degree students should demonstrate a higher awareness of universal design and the results of their studio works should be of higher quality in terms of universal design application compared to the Bachelor students.

RESEARCH METHODS

The first method of evaluating was the anonymous questionnaire. The questionnaire was focused on the awareness of Bachelor's and Master's degree students about universal design. The goal was to verify, based on the answers, whether they gained sufficient awareness during their studies to apply the acquired knowledge into their architectural design studio works. The questions asked in the questionnaire were in the form of a combination of eight mandatory single-answer multiple-choice questions (require respondents to click only one answer) and two optional open-ended questions (require respondents to type their answer).

The questionnaire created in the Google Docs application was distributed to all students of the FAD-STU. To compare the success of questionnaire responses in individual years of study, mandatory questions, except the first one (select the year of study), were also evaluated quantitatively. Depending on their nature, points were assigned to the individual answers to the questions. For questions with a single correct answer, the student could get 1 point or 0 points, for qualitative questions, points were assigned based on the selected quality measure in the range of 0 to 1 point. The maximum possible number corresponded to 6 points (100%).

The second method used was a qualitative evaluation and comparison of the outputs of student studio works following universal design based on an evaluation checklist. This checklist was derived from the official access audit checklist used by FAD-STU experts to assess the accessibility of public buildings within various projects for municipalities and ministries. The checklist had been simplified, as the research aimed to evaluate architectural studies and not real

buildings. Two groups of items were distinguished in the checklist. The first group monitored the application of legislative requirements related to the accessibility of the built environment. In the second group, items beyond the scope of legislative requirements were monitored, such as recommended standards and principles of universal design. Individual items in the checklist were scored, while the point gain depended on whether the item in the proposal was correctly designed or absent. A theoretical maximum score of 100 points represents a fully accessible environment. If the item was irrelevant (it corresponded to another typological type of architecture), it did not influence the final evaluation.

The evaluation checklist consisted of seven assessment categories including relevant items:
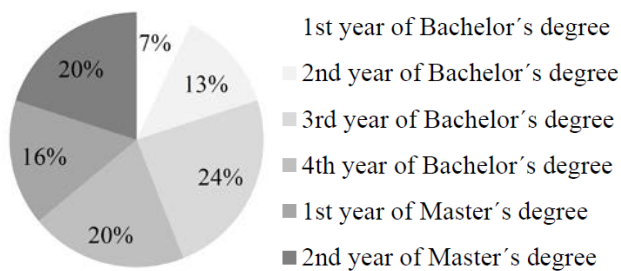
A. Accessibility of public space (availability of public transport, accessible public space, orientation system, parking);
B. Entrance to the building (space in front of the building, accessibility of entrances, correctly designed ramp, etc);
C. Entrance hall and corridors (entrance hall accessibility, width of corridors, orientation, manoeuvring);
D. Vertical circulation (accessible lift and its location, correct design of the staircase);
E. Accessible toilets (presence of accessible toilets, proper design of toilets);
F. Operating premises (accessibility of exhibition spaces, halls, sports facilities, shops, restaurants, offices, etc);
G. Evacuation (means of evacuation - lift/stair/ramp, safe areas at escape routes).

To verify the hypothesis, the works of students in the second, fourth, fifth and sixth year of study were assessed and compared. The works from the first year were not suitable for assessment due to their small complexity. The studios in the third year are focused on urban design and monument restoration, so they were also excluded from the assessment. To achieve relevant results when comparing the quality of the works, the studio works of the same student in different years of study were compared.
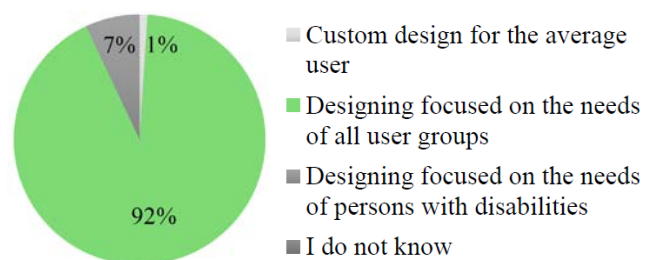
RESULTS

The total number of respondents in the questionnaire was 97 students (14% of FAD-STU students). Questions 1-8 and their qualitative results are presented in Figure 1.
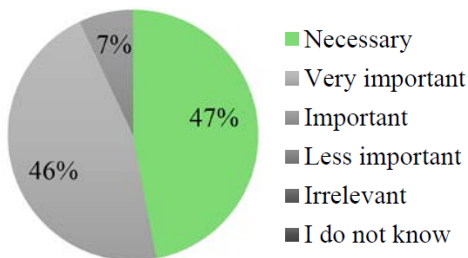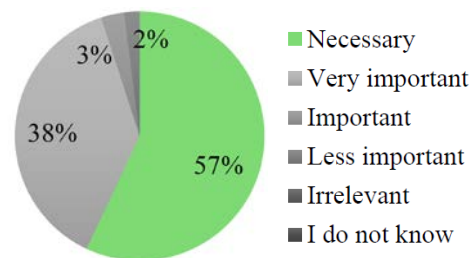

01: Year of study

- 1st year of Bachelor´s degree
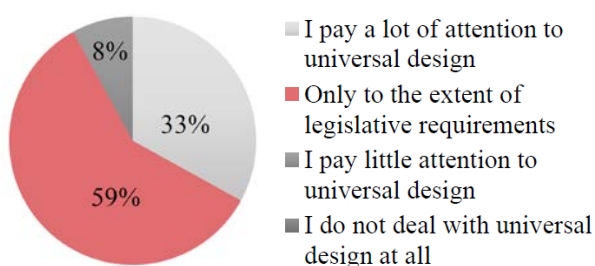- 2nd year of Bachelor´s degree
- 3rd year of Bachelor´s degree
- 4th year of Bachelor´s degree
- 1st year of Master´s degree
- 2nd year of Master´s degree

02: What is universal design?

- Custom design for the average user
- Designing focused on the needs of all user groups
- Designing focused on the needs of persons with disabilities
- I do not know

03: I consider the application of universal design in relation to architectural design to be:

- Necessary
- Very important
- Important
- Less important
- Irrelevant
- I do not know

04: I consider the application of universal design in relation to urban design to be:

- Necessary
- Very important
- Important
- Less important
- Irrelevant
- I do not know

05: How much attention do you pay to universal design in your studio work?

- I pay a lot of attention to universal design
- Only to the extent of legislative requirements
- I pay little attention to universal design
- I do not deal with universal design at all

06: How much attention is paid to universal design during studio work consultations?

- Regular discussion about universal design
- Discussion how to meet only legislative requirements
- Sporadic discussions about universal design and accessibility
- Neither universal design nor accessibility is discussed
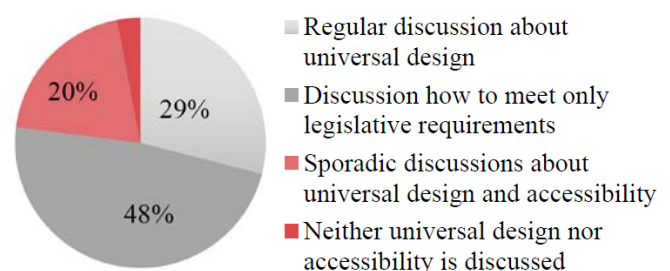
07: Which of the following statements do you most identify with?
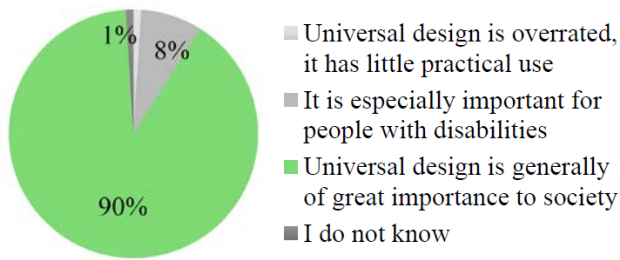
08: Do you have a personal experience where you appreciated a universally designed environment?
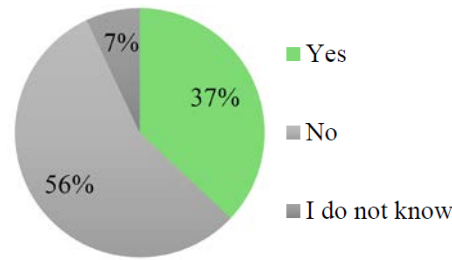

Figure 1: Quantitative results of the questionnaire, questions 1-8.

Questions 9 and 10 allowed students to freely describe their personal experiences and further considerations on the issue of universal design. The last question about further considerations and suggestions on the issue of universal design provided very interesting answers, for example:

> *Thanks to the Universal Design course, I notice my surroundings more. I notice people with disabilities and how they act in the environment and how the environment affects their actions. For example, a blind man was wandering around round flowerpots and could not find the right way, so a passer-by had to help him. From this, I evaluated that the circle is the worst shape for the orientation of the blind and I will avoid it in the designs of public spaces.*

The questionnaire indicated that students consider universal design to be an important part of architectural and urban design studio work. Students generally pay considerable attention to universal design in studio work, but almost 25% of consultations are insufficient. Although students mostly know that universal design is not only a matter of barrier-free solutions, even so, they mainly focus on this aspect. Even though only 37% of the students had a personal experience when they appreciated universal design, up to 90% considered universal design to be extremely important. The personal experience of students with universal design according to the questionnaire is summarised in Table 2.

Table 2: Personal experience of students with universal design according to the questionnaire.

The most frequent situations in which students appreciated the universally designed environment:	Universal design elements that students appreciated most:
• mobility problems due to injury • movement with a pram or wheelchair • travelling by public transport • carrying heavy objects • movement of older people • use of the environment by a wide range of users	• accessible lift and ramp • accessible toilet and bathroom • accessible apartment • public transport facilities • adaptable elements (e.g. height-adjustment) • lowered kerbs • haptic models

The analysis of the checklist identified the following strengths and weaknesses of students' studio works from the universal design perspective listed in Table 3:

Table 3: Strengths and weaknesses of students' studio works.

A. Accessibility of public space	
+ properly designed accessible parking places (Figure 2 and Figure 3)	- public transport is difficult to access - lack of a visual orientation system
B. Entrance to the building	
+ the best-managed problem of universal design including correctly designed ramps (Figure 3)	- entrances to businesses are often illogically located far from the street
C. Entrance hall and corridors	
+ the main entrance door is wide enough for all (Figure 2 and Figure 3)	- corridors on the 1st floor are designed generously compared to communications on other floors - lack of natural light in the circulation spaces
D. Vertical circulation (lift, staircase)	
+ preference for straight arms and simple stairs (Figure 2 and Figure 3)	- the staircase is the dominant feature of the space, but the location of the lift is hard to identify (Figure 3) - use of the smallest suitable lift, there is no space reserve for bigger electric wheelchairs

| E. Accessible toilets	
+ location in the object	- the accessible toilet has standard dimensions, but it has shortcomings and is impractical (Figure 2) - insufficient space in front of the toilets (Figure 2)
F. Operating premises	
+ rethinking the accessible route from the entrance through the dressing room to the exhibits, including a visit to the toilet (Figure 3)	
G. Evacuation	
	- underestimation of escape routes and minimal dimensions of spaces - the possibility of escaping from the interior directly to the exterior is being forgotten
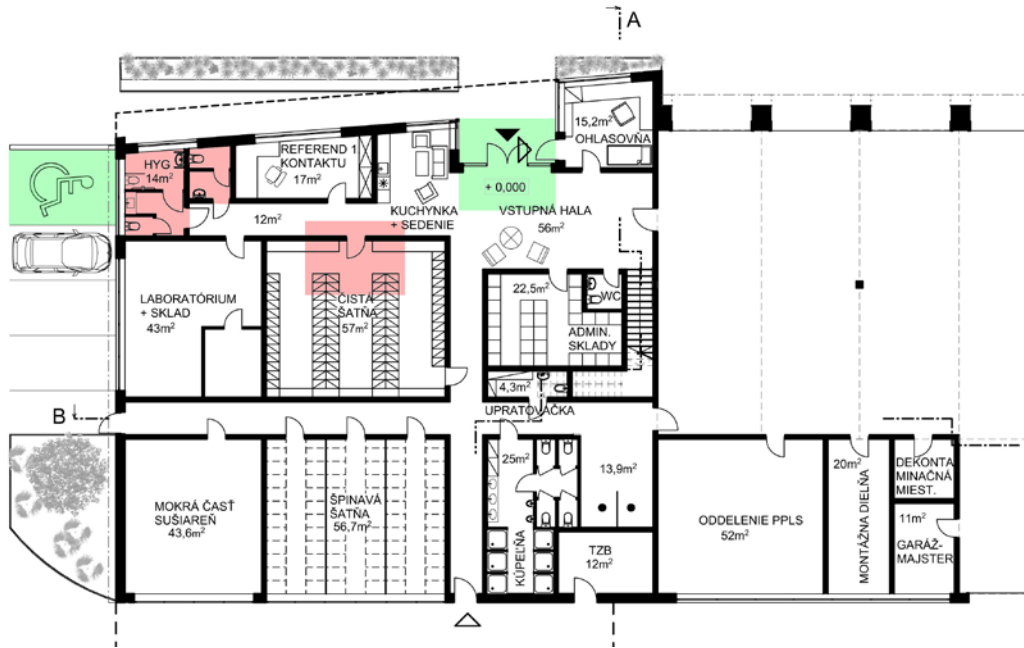
Figure 2: Fire station - first floor, scale 1:100, student K.K., 2nd year of study. Red marks indicate inappropriate solutions, green - appropriate.
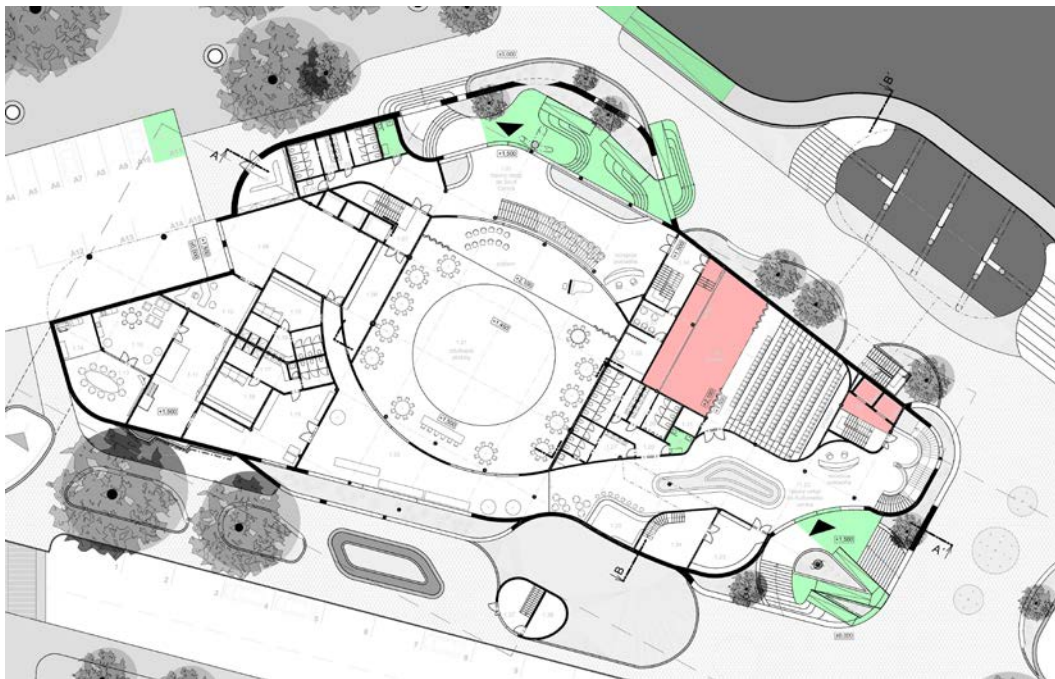

Figure 3: Sci-fi Centre, first floor, scale 1:200, student K.K., 5th year of study. Red marks indicate inappropriate solutions, green - appropriate.

Comparing the students' results, it can be assumed that both the questionnaire and the checklist demonstrated progress between the Bachelor's and Master's degree of study (Figure 4). The evaluation of the questionnaire score continuously increases from the first to the fourth year of study, in which students complete the compulsory subject on universal design. Although there is a slight decrease in the fifth and sixth year of study, based on the checklist it can be said that the quality of knowledge implementation in studio works continues to rise.

It is noticeable that the time lag between the acquisition of theoretical knowledge and the ability to apply it in practice is gradually disappearing. There is also an obvious shift in the perception of universal design issues, it is no longer just about fulfilling legislative requirements, but about the thoughtful involvement of universal design in the project concept, as student M. Križo stated in his diploma thesis:

The municipal swimming hall is designed with a focus on meeting the needs of a wide range of occupancy, therefore emphasis is placed on universality, barrier-free access, multisensory experience, and safety [9].
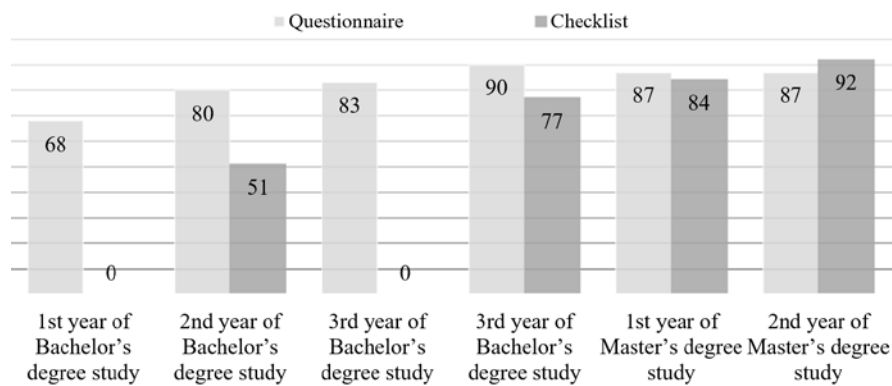

Figure 4: Comparison of the average score in percentage by year of study between the questionnaire and the checklist.

CONCLUSIONS

Universal design is an essential part of architectural design, as the built environment must be accessible, usable and perceptible for all people. Currently, great emphasis is placed on the creation of a non-discriminatory built environment, which is also a condition for projects financed by European structural funds. In practice, however, there are still visible examples of inadequate implementation of universal design. Therefore, the education of future architects on this issue is very important.

This research identified that it is not enough to master the basic legislative regulations in the field of accessibility. It is necessary to educate in the principles of universal design, researching the needs and requirements of different people in the built environment and linking theoretical knowledge with practical implementation.

The research demonstrates that it is very important to sensitise students' interest in the issue of user diversity in the built environment, their needs and demands right from the beginning of the studies. The research results can be summarised into the following conclusions:

1) Students are generally very interested in universal design, they notice the diversity of users in the environment;
2) In the design process, most Bachelor's degree students do not deal with universal design beyond the scope of legislative regulations;
3) Master's degree students generally put more emphasis on universal design, not only in the area of physical accessibility of the built environment, but also in the area of cognitive accessibility - multisensory solutions, as well as aspects of well-being;
4) More intensive consultations can help apply theoretical knowledge to studio works. The expertise of teachers in this subject area is also of great importance in the field of implementation of theoretical knowledge of universal design in studio works.

The level of education at architectural schools in the field of universal design has a great influence on improving the situation of universal design implementation in practice. A teaching model can be recommended that would properly link theoretical subjects on universal design with practical subjects in which students directly apply universal design principles in the design process.

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BIOGRAPHIES

Zuzana Čerešňová graduated from the Faculty of Architecture and Design of Slovak University of Technology in Bratislava (FAD-STU), Slovakia, in 1997. She completed her PhD in 2001 at the same faculty. Currently, she is an associate professor and Vice-Dean for Research in the FAD-STU. She is a member of the Centre of Design for All (CEDA) and a lecturer and supervisor of the subjects Universal Design, Public Buildings, and Design Studios. She focuses on designing an inclusive educational environment, age-friendly environment, social care facilities and cultural facilities. She is a project manager and researcher participating in various projects focused on human-centred design methods. In the academic year 2015-2016, she was awarded the Fulbright Grant for a research stay at the Institute for Human Cantered Design in Boston, USA. She is a national expert on accessibility in the Accessible EU consortium and a member of the board of the EIDD - Design for All Europe.

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Klára Macháčová graduated from the Faculty of Architecture and Design of Slovak University of Technology in Bratislava (FAD-STU), Slovakia, in 1994. As a practising architect, she was involved in designing buildings for housing, administration, healthcare, education, commerce and industry. She completed her PhD in 2011 in the FAD-STU. Currently, she is Vice-Dean for International Relations and Public Relations at the FAD-STU, and a university teacher at the Institute for Ecological and Experimental Architecture also in the FAD-STU. She is a lecturer and supervisor of the subjects Architecture and Environment, Ecological Aspects of Architectural Design, and leads Design Studios. She focuses on designing sustainable architecture and urban environments. She is involved in various projects focusing on different aspects of sustainability, from the use of renewable sources of energy in architecture to the social aspects of sustainability in the context of universal design.

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