Revision of architectural design education in terms of sustainability, creativity and digitalisation

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ABSTRACT: The article explores different educational strategies in relation to architectural design courses, focusing on sustainability, creativity and digitalisation. The starting point for this research was a t-survey (t-teachers) among 40 teachers of architectural design from eight European universities, to examine different programme frames and the teachers' attitude *versus* the design process. The survey findings facilitated the identification of two fundamentally contrasting programme models, one at Gdańsk University of Technology (Gdańsk Tech), Poland, and the other at Ljubljana University, Slovenia. These models were subjected to detailed comparison, along with the corresponding teaching methods, based on a proposed universal model of the design process. Finally, a fusion of approaches was proposed and implemented in an intensive workshop, called *There is no Planet B*, conducted at Gdańsk Tech in 2022. Results of the workshop were verified through an s-survey (s-students) conducted among 20 participants of the course, pointing to the value of performance in the development of creative skills and participatory design, and the potential of the video format for public debate on sustainability.

Keywords: Architectural design education, educational strategies, sustainable development, creativity, digitalisation

INTRODUCTION

The rapidly changing world demands a revision of the existing educational strategies for the architectural studio teaching-learning process, so that universities could respond to the challenges and be prepared ahead considering the greatest possible global challenges. The pedagogical process over the past 20 years has rapidly changed because of the Internet, computer programmes, technological developments and access to open databases. Hence, given these changes, a revision of architectural education needs to be seriously discussed, in the light of digitalisation, sustainability, as well as market forces. Educational strategies should offer multidisciplinary approaches, different teaching and learning methods, assigned tasks and design communication techniques [1].

It demands various mind strategies and techniques of resolving problems facilitated by critical thinking and creativity, as outlined in studies on research by design [2], design thinking [3], complex thinking [4] or metaphorical reasoning [5-6]. Moreover, the architectural education process should also incorporate complex knowledge on sustainability [7][8], allowing for responsible designing. Facing the great development of digital tools, architectural strategies have to be flexible in terms of interactive solutions [2][9], parametric design [2], immersive reality [9] and the role of artificial intelligence [10].

The Danish Royal Academy addresses the challenge in its new vision for 2050 and a new strategy for 2022-2025 called: Create. Collaborate. Change: towards a Balanced World [11]. This strategy stresses the importance of creativity, digital technologies, sustainability, scientific and artistic research, as well as collaboration with external stakeholders. It demands the verification of existing programmes at architecture faculties. The starting point to this kind of discussion was a t-survey among 40 teachers of architectural design to examine programme frames at different European universities and teachers' approach to the architectural design process at different stages, conducted in 2022.

It led to a more detailed comparison between two diametrically different programme models of the architectural design course from two universities - from Gdańsk University of Technology (Gdańsk Tech), Poland, and Ljubljana University, Slovenia. For both programme models, two methods were compared in terms of sustainability, creativity and digitalisation. Finally, these methods were combined in a jointly conducted course called: *There is no Planet B*, oriented on sustainability, and verified through an s-survey among 20 members of the course. The article presents different approaches to the programme frames of architectural design classes and to the teaching methodologies, to achieve a more efficient and comprehensive response for the contemporary design studio.

RESULTS OF THE T-SURVEY - FROM THE PROGRAMME FRAMES TO THE ATTITUDE TO THE PEDAGOGICAL PROCESS

The aim of the t-survey conducted among 40 teachers from architectural design from eight different universities in Europe, was to check the programme and organisational frames of architectural design classes, including important aspects in terms of their pedagogical process, important areas of research, the ways of communication between teacher and students, and the tasks and demands incorporated during classes, in relation to each stage of the process. Table 1 presents the main characteristics of the involved teachers from eight universities regarding the organisation of architectural classes at their respective universities. The differences are visible is the duration of the design process, starting from one semester up to two semesters, weekly meeting frequency and an hourly range of the meetings. This juxtaposition is the basic step to discussing the desirable frames of architectural design studio.

Table 1: The results of the survey - different programme and organisational frames of the selected classes of architectural design.

University (number of participants)	Studies - no. of semester	Weeks in a semester	Weekly meeting frequency	Duration of a meeting (h)	Duration. of one project (semester)	No. of students in one group
Ruhr-University, Bochum, Germany (1)	12	16	1	5	1	30-40
Gdańsk Tech, Poland (18)	11	15	1	4-5	1	13-15
Universidade Lusófona, Lisbon, Portugal (5)	10	15	2	5,8, >8	1	20
University of Ljubljana, Slovenia (6)	10-11	14-15	2	4-6, >8	2	10-25
University of Navarra, Pamplona, Spain (1)	10	14	1	4	1	25
University of Pavia, Italy (2)	10	14, <14	1-2	8,>8	1	35-40
University of Split, Croatia (4)	10	15	1-2	4-5	1	13-20
University of Trieste, Italy (3)	10	15	1	4-8	2	10-25

Teachers were asked to choose maximum four most important aspects in terms of their pedagogical process. Their answers have been ranked in the following order: design process (75%), defining the problem (70%), stimulating creativity (62.5%), involvement of students (55%), group discussions (45.7%) and strong idea of the design (45.7%). Less important aspects in terms of their pedagogical process were: individual critique (20%), final design (20%) and technical difficulties (5%). Teachers were also asked about these elements presented in pairs, and from that perspective, the authors of this article noticed some ambiguity in the responses to the previous question, which could also be interpreted as synergy. Sixty percent of the surveyed teachers pointed that both: the design process and final design were equally important in terms of their pedagogical process, but in the former question, final design was chosen only by 20% of the respondents. A similar situation can be observed in regard to stimulating creativity and explaining technical and legal issues. Fifty-five percent of the surveyed teachers pointed that both these aspects were equally important, but in the previous question technical difficulties were selected only by 5% of the surveyed teachers.

Teachers were also asked about the need for research connected to the design studio. Sixty percent of the teachers admitted that it was critical and 32.5% marked that it was crucial. When asked to select maximum four important answers to the question, why it was important (multiple choice), they answered as follows: to define the problem - 85%, to understand the context - 80%, to extend the theoretical background - 65%, to find the architectural references (examples) - 45%, depends on the project - 45%, to understand functional requirements - 12%, to understand legal requirements - 3%.

Teachers were also asked (multiple choice) to select five most important thematic aspects for them in view of their pedagogical approach, and they responded in the following order: social and cultural aspects - 82.5%, environmental aspects - 70%, functional aspects - 67.5%, aesthetic aspects - 60%, theoretical background, 42.5%, heritage validation 40%. Less frequently chosen aspects were: technological aspects 30%, architectural references (examples) - 32.5%, construction and installation aspects - 17.5%, legal requirements - 17.5%, economic aspects - 10% of the teachers.

The results of the survey identify the differences in the programme frames related to architectural design classes at the selected universities, the complexity of the design process and the importance of two components within architectural design classes - design and knowledge. The latter aspect will be used in further assumptions for the universal model of the design process (Figure 1), where two parallel paths in teaching architectural design are distinguished: an analytical path connected to acquiring knowledge while conducting research, allowing for problem-oriented design; and a conceptual path related to design process and creativity, leading to the final concept. Analysing the results of the survey in the light of sustainable development, it is visible that the social and cultural aspects, as well as the environmental ones, are crucial for architectural design teachers. Less attention is paid to the economic factors what can be related to the fear that it could block students' imagination, but the real market situation shows the opposite.

RESULTS OF THE T-SURVEY IN TERMS OF TOOLS AND COMMUNICATION DURING THE DESIGN PROCESS

The goal of the t-survey was also to check the importance of different digital tools at different stages of the design process in comparison to the other tools. Teachers were also asked to point out the tools crucial for the design process at its different stages. Manual tools, such as freehand sketches and mock-ups are crucial in the first two stages of the process. In the initial phase, the role of mock-ups is slightly more important than digital 3D modelling, and in the advanced phase, it is the opposite with the digital models nearly twice as important as the mock-ups. It is visible that GIS-based analysis and 3D modelling are perceived as crucial digital tools for the design process. In contrast, 3D scanning, immersed reality and parametric design are not so relevant for the surveyed teachers of architectural design.

Table 2: Results of the t-survey on crucial tools at different stages of the design process.

Question: Point out the tools crucial for you during the design process at different phases (responses in %).				
	Predesign phase	Design - initial phase	Design - advanced phase	Digital tools
Urban analysis	95.0	27.5	5.0	
Surveying residents/future users	72.5	22.5	5.0	
GIS-based analysis	65.0	10.0	0.0	x
3D scanning	35.0	20.0	12.5	x
Ideograms	55.0	75.0	12.5	
Mock-ups	57.5	75.0	30.0	
Freehand sketches	80.0	75.0	37.5	
3D modelling	25.0	62.5	72.5	x
Functional diagrams	47.5	67.5	20.0	
Parametric design	10.0	40.0	42.5	x
Immersed reality	5.0	25.0	42.5	x

The survey also examined the way of communication in different stages of design as shown in Table 3, considering also digital ways of communication. It can be observed that in predesigns and the initial phase of design, the most preferable ways of communication are: group discussion with a whole group and discussion in small groups of students (about three-five students).

Table 3: Results of the t-survey on important elements at different stages of the design process.

Question: Mark the elements of the pedagogical process that are important for you at the following stages of design process (predesign and two stages of design) (responses in %).				
	Predesign phase	Design - initial phase	Design - advanced phase	Digital tools
Group discussion (whole group)	95.0	50.0	30.0	
Teacher's public critique	35.0	85.0	60.0	
Students' public critique	42.5	70.0	47.5	
Individual consultations	25.0	67.5	77.5	
Discussion in small groups (3-5)	52.5	65.0	35.0	
Comments on e-learning platform	35.0	45.0	32.5	x
E-mails, Facebook, WhatsApp	35.0	42.5	47.5	x
Internal critique	60.0	67.5	52.5	
External critique	27.5	47.5	70.0	

Teacher's public critique on students' works and individual consultations are mostly used in the initial and the advanced phase of design. Internal critique is considered useful at all three phases of the design process, whereas the external critique is mainly applied in the advanced phase of design. It is visible that digital communication with students is not highly practised, but is more important in the initial phase of the design, with e-mails, Facebook and WhatsApp continuing to be important in the advanced phase.

The survey also examined the last stage of the architectural design process, related to presentation, to consider different digital forms of presentation *versus* the traditional ones. Teachers were asked what media and tools they required students to use at the stage of presenting the final architectural concept (multiple choice). The most popular answers were: graphic boards (prints) - 75%, 3D visualisations - 65%, multimedia presentation - 55%, booklet portfolio - 50%, mock-up - 47.5%. Less frequently chosen answers were: prototype (1:1 - 1:20 scale) - 15%, video - 10%, 3D animation - 7.5%, performance - 5%, immersed reality - 2.5%. The responses clearly indicate that the most typical form of presentation are graphic boards. Teachers started to experiment also with new tools like video, performance or immersed reality, but they are still not really popular.

As demonstrated in Table 1, two extremely contrasting programme models of architectural design classes can be identified, one from Gdańsk Tech (model A) and the other one from Ljubljana University (model B), in terms of the number of hours, frequency of meetings and the duration of the process. Different programme models determine different organisation of the courses and different methods for architectural design classes. In this article, two methods will be compared: method A (associated with programme model A) by K. Życzkowska from Gdańsk Tech, and method B (associated with programme model B) by Š. Hudnik from the University of Ljubljana. To compare both methods, the universal model of the design process is proposed, consisting of four main phases: predesign, initial phase of design, advanced phase of design and presentation. All four phases consist of two main paths of education: an analytical path and a conceptual path, influenced by the method of teaching and other stimuli, related to the ways of communication, students' motivation related to their personal experience (Figure 1).

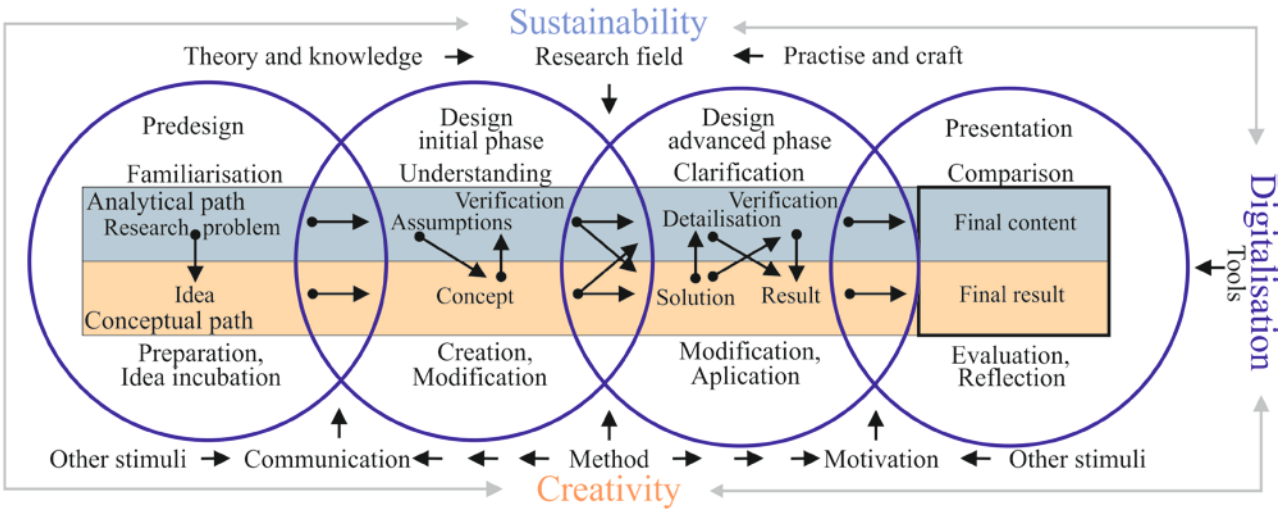

Figure 1: Universal model of the design process in the light of sustainability, creativity and digitalisation.

Differences in the outlined methods for architectural classes are related to the programme models, but they also occur in terms of creativity stimulation connected to a set of anticipated tasks of the chosen method. The design process varies also depending on the scope of digital tools related to the process, influencing both paths. Moreover, the research field pertinent to the course directly influences this process, but sustainability emerges as a common focal point in both analysed methods. These interrelations are depicted in Figure 1. While the universal model (Figure 1) delineates similarities in the design process, discrepancies in the duration of successive phases are evident, as outlined in Table 4.

Table 4: Comparison of method A associated with programme model A and method B associated with programme model B.

	Predesign phase		Design - initial phase		Design - advanced phase		Presentation		Total	
Method (for model)	A	B	A	B	A	B	A	B	A	B
Weeks	1-3	1-10	4-6	11-18	7-13	19-26	14-15	27-30	1-15	1-30
Number of weeks	3	10	3	8	7	8	2	4	15	30
Hours per day	5	8	5	8	5	8	5	8	5	8
Meetings per week	1	2	1	2	1	2	1	2	1	2
Total number of hours	15	160*	15	128	35	128	10	64	75	480
Ratio of B/A hours	10.66		8.53		3.65		6.4		6.4	

*Note: 70 hours of the course of the predesign phase are replaced by an intensive workshop trip

Model A consists of a single semester design process, with four-five hours weekly over 15 weeks. In contrast, model B extends over 30 weeks, with bi-weekly eight-hour meetings. Model A focuses on one architectural project within a semester, while model B spans two semesters for a single project. Model A accommodates 13-15 students of the same age, each pursuing individual tasks. Model B forms groups of 10-25 students across semesters (maximum five from one semester), tackling individual tasks of varying complexity within the same theme.

The advantages of both models are different. Model B can strengthen the collective learning ability, allowing to learn from older colleagues. Model A offers two distinct thematic paths yearly, fostering creative thinking. Conversely, model B provides much more time for analytical and critical thinking, enhancing concept development and presentation. However, it should be stressed that model B has six times more hours dedicated to the course, so the difference is huge. The contrasts are also visible in the duration of phases, especially at the first two stages (Table 4).

The time allowance for the analytical path in model A is much more reduced in comparison to model B, so method A assumes that only necessary analysis will be conducted to define the problem based on a general topic proposed by the teacher and due to urban analysis and shared catalogues of existing solutions developed in small groups. The analytical trajectory is guided by the teacher through targeted exercises covering diverse topics, such as functionality, evacuation procedures, technical considerations and sustainable solutions. This structured approach aims to optimise class efficiency across various stages of the design process.

In contrast, method B, in first stages offers extended activities following the analytical path, like meetings with authorities or external lectures, allowing for in-depth analysis of the wide range of general topics. It is crucial that method B offers an intensive workshop trip lasting seven days in the predesign phase, instead of systematic meetings at university, to prepare a comprehensive analysis for the design location, including surveying local people.

Moreover, in the advanced phase of the design it offers external critique, allowing reflection on the projects. The conducted comparative analysis reveals that the most analogous phase across both methodologies occurs during the advanced phase of design, spanning seven weeks in method A and eight weeks in method B. This suggests that the preparation of drawings and visualisations typically requires approximately two months on average. However, the presentation time is notably longer in method B compared to method A.

Consequently, in method A, individual presentations dominate, while in method B, a unified graphical language is adopted for all projects, aiming for a sophisticated exhibition standard. Furthermore, in method B, students have the opportunity to experiment with various digital media formats, including video and Instagram exhibitions. Additionally, they engage in performance art or compile booklets, diverging from the graphic board used in method A.

In terms of sustainability, the general topics of sustainable development goals, friendliness of space and resistant space, related to the analytical path, link both methods. However, in method A, more emphasis is placed on environmental solutions and green architecture, while in method B the social aspects are crucial, based on participatory design, using elements of performance.

In regard to creativity, in method A, the stimulation of creativity is based on metaphorical thinking, based on ideas from other domains, starting with ideograms and their interpretation in the abstract mock-ups. It accelerates the process, while requiring engagement and efficiency to swiftly define the architectural concept's frames considering conclusions from the analytical exercises.

In method B, the process is highly problem-oriented, with students conducting in-depth research to define the research topic. They illustrate it with abstract collages focusing on social, spatial and sustainable needs, as a foundation for conceptual mock-ups. In method B, concentration on the chosen topic and self-discipline are crucial to avoid distractions and maintain focus on the selected design path.

The use of digital tools is stronger in method B because apart from the GIS-based analysis at predesign, students experiment with digital tools at the stage of presentation, preparing a video. Any of the two analysed methods is based on parametric design, but in both digital modelling is an inherent element of classes, allowing for many iterations during the process. Even the phases of the process differ in duration, the content and scope of results. Both methods demand stimulation of creativity, abstract thinking and critical thinking, but in the case of method A, the effectiveness of classes is crucial, and in method B - students' self-discipline and concentration on the chosen topic.

INTENSIVE WORKSHOP *THERE IS NO PLANET- B* - FUSION OF APPROACHES

An intensive workshop conducted at Gdańsk Tech in 2022 was an opportunity to exchange experiences of teachers from the two above-mentioned universities. The workshop - the Elective Design course called: *There is no Planet B* was oriented on sustainability and lasted five days (eight hours/day) for students of the last semester of the architectural studies.

Figure 2: Compilation of student-generated videos showcasing performances during the intensive *There is no Planet B* workshop held at Gdańsk Tech (authors of the videos from the left: group 1: M. Draheim, A. Jarkiewicz, A. Malec, A. Rudnicka, M. Sokolnicka; group 2: P. Łukaszewicz, L. Myślińska, D. Pisarska, I. Wojnowska, J. Łukomski, M. Kornacki; group 3: P. Bednarska, K. Białek, K. Bialoglowska, M. Czopka, D. Trzcińska) (photographs by K. Życzkowska).

The goal of the course was to offer an entirely different task to the one that students from Gdańsk Tech were familiar with, to encourage them to deal with different media, to fill the gap in the students' experience. The task was to create two performances in the group of five or six, on the topics: 1. Go Green! and 2. Go Public!, to create a zero-cost or low-cost zone for social interactions, to interact with people in a real space, discuss sustainability, and to use digital media (video and Instagram exhibition) for the presentation. In Go Green! - the task was to discuss the lack of greenery and the heat island problem, and in Go Public! - to create a public place in view of inclusive design and to discuss the need for public spaces.

These experience yielded very interesting results, although students were perplexed at the first stage of the task. Eighty percent of the students (20 out of 25) taking part in the course participated in the s-survey that gauged their impressions about the course, and allowed the authors of this article to draw conclusions related to the course. Eighty percent of the students admitted that they liked the task related to the real-time intervention and that they were satisfied with taking part in the course. The same percentage (8%) stated that it was easier for them to organise the second intervention. Fifty-five percent of the students acknowledged that they dealt with performances for the first time in their life. Seventy-five percent of the students prepared a video for the first time during their studies, and also 75% admitted that the video is an interesting way to present the design process. Seventy percent of the students indicated that that experience gave them another perspective on designing. The results of the s-survey prove that it is valuable to mix different approaches in architectural design and to experiment in the field of sustainability, creativity and digitalisation.

DISCUSSION AND CONCLUSIONS

The results of the t-survey and the resulting comparison of programme models and teaching methods from two different universities shed light on the diverse educational strategies deployed in architectural design education. This prompts a crucial discussion regarding the preferred emphasis of such courses: should they deal comprehensively with analytical research or focus mostly on conceptual exploration? Moreover, while addressing environmental and social concerns vital for sustainability, should more attention be directed towards economic factors? Another significant aspect is the integration of digital tools into architectural practice. The debate extends to whether traditional methods like paper mock-ups should give way to digital modelling, BIM, parametric design and emerging technologies, such as artificial intelligence or immersive reality.

The findings of the t-survey indicate that architectural education is currently navigating through a period of digital transformation. Consequently, educators must remain adaptable, experimenting with new technologies and fostering discussions on architects' roles in the sustainability discourse. Elective courses have emerged as a valuable avenue for exploring diverse fields and media. Initiatives like *There is no Planet B* exemplify how these courses can address gaps in students' education, encouraging new challenges, including enhancing creative performance, engaging in public discourse, utilising video as a medium for spatial dialogue, and implementing cost-effective strategies to enhance public spaces.

Given the significance of sustainability, creativity and digitalisation in architectural education, it is imperative to offer students a range of tasks and reference points. This approach hones their skills in these areas and cultivates analytical thinking, teamwork and participatory design, thereby enhancing their sensitivity to user needs and sustainable development goals.

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