THE APPLICATION OF DESIGN THINKING METHODOLOGY IN ARCHITECTURAL EDUCATION IN UKRAINE: CASE STUDY

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Abstract

The relationship between different aspects that challenge architectural education in Ukraine and new pedagogical strategies, in particular application of the innovative approach based on Design Thinking, are analysed and described in the paper. The case study illustrated in the article is based on author's personal experiment held with the 3rd year students at the Institute of Architecture, Construction and Energy (Ivano-Frankivsk National Technical University of Oil and Gas, Ukraine). A qualitative analysis of the Design Thinking methodology, alongside the literature review, has been presented . Particular emphasis is put on the implementation of the Lego® Serious Play® methodology, as an effective tool for facilitating students' creative potential, self-expression and ability to generate innovative ideas at the conceptual stage of architectural design. The suggested methodology can be successfully applied in other higher educational courses.

Keywords: **Design thinking models; Architectural education; Innovative pedagogy; Higher education; Architectural design; Lego serious play.**

1. INTRODUCTION

Traditional models of the architectural education in Ukraine today are undergoing revolutionary changes under the influence of world educational tendencies and the current demands for professional architectural practice as well as challenged greatly by a wide spectrum of technological advancements like digital manufacturing and fabrication, geometric optimization of free form structures, digital tools for analysis of building performance [1]. Increasingly, new modes of information sharing and new fast-growing concepts and technologies such as Information Modelling (BIM), virtual and augmented reality, animation, visualization, 3D printing and drones have revolutionized the field of architecture, design and engineering.

This has caused the tremendous impact on the need of improvement of existing tools and methodologies for architectural education in Ukraine, methods of translating professional knowledge and means of activity, and general architectural practice.

Traditional drawing tools are gradually losing their relevance, even at the stage of idea generation. And this is quite naturally driven by the desire to accelerate and optimize the design process, as well as to meet the requirements of future employers, putting increasing demands on the professional software mastering skills in the field of architectural design, 3D modelling and visualization.

In this regard, the problem of development not only students' professional traits, but also their creative potential is of particular relevance [2].

The huge role of teamwork and creative problem solving is still neglected in Ukrainian educational system,

while in most developed European countries, the educational approaches are aimed at the enhancement of self-expression and creative problem solving skills, crucial for shaping students' future orientations and self-actualization [3].

Thus it becomes important to acquaint students with specific design thinking techniques, that are developed to simplify and diversify the learning and working process. The paper analyses various approaches of the Design Thinking in architectural education, puting special emphasis on the application of Lego Serious Play technique, which has been used as a powerful facilitation tool in recent years in the field of higher education. Additionally, the paper sheds light on the current situation in the field of Architectural education in Ukraine, its challenges and prospects, new educational strategies and presents the application of authors teaching approach based on implementation of the Design Thinking methodology.

2. THEORETICAL DISCOURSES

Recently a number of studies have been conducted [4–12] to determine the professional and personal skills required from young professionals in architecture and design industry. These studies have indicated some key concerns: today's architects need to possess a wide range of skills and competences in business and psychology; they need to have strong teamwork skills; know how to apply a wide range of creative problem-solving technics and professional computer skills in practice; be able to work with stakeholders from diverse spheres. The 21st century architect must be able "to deal with a rapid pace of technological world, and complex problems requiring multidisciplinary solutions" [5].

Thus modern architectural education suffers huge transformations "moving away from thinking of students as passive listeners to active learners" [8], engaging them in a mutual communication and active dialog.

Analysing the professional training of future architects in European countries, it is necessary to note the purposeful formation of creative traits in teaching, motivation to invent students' own ways and creative mind-set. At the same time, architectural education in many countries suffers from a number of problems. Observations and research on the case of architecture students in Iran that have been conducted by Iranian scientists [9] have shown that there is a lack of vital skills of critical and creative thinking which substantially challenges modern architectural education. Indeed, nowadays architecture students experience confusion throughout the design process, in particular at the stage of generating ideas [9].

The same problems were observed in Ukraine. It is noted in a number of investigations conducted by Ukrainian scientists [10] as well as in author's personal experience as an educator. In a number of scientific works a possible solution for this problem is seen in the Design Thinking methodology which is considered to be one of the most powerful tools for stimulating creative idea generation which could be widely used in the educational process.

Danfulani, B. draws parallels between the stages of designing an architectural object and the stages of the methodology of design thinking, noting that each architectural project process starts with a defined problem and continues with a series of solutions through which different ideas are generated, tested against clients demands and implemented into built form [6]. The author considers creativity and innovation as the crucial factors that incorporate new concepts and methods in architectural design problem solving process [6].

Cross notes that design process, including a large number of ideas and decisions, requires a creative approach and ability to generate and evaluate ideas [13]. Thus, the pedagogical approach promoting design thinking and the special guidance through the design process are extremely essential for future architects and their ability to generate ideas [9].

Design Thinking methodology today is well known as a powerful problem-solving tool often used in business organizations for generating innovative solutions and improving creative confidence. Companies and enterprises worldwide are applying this human-centered technique into their business practices for deep understanding of human needs and desires, and thus, design better solutions and products to meet those needs [14, 15]. The term "design thinking" is widely spread in the scientific literature of different fields. In relation to architectural and design sphere it was first used in Bryan Lawson's book, "How Designers Think" [16] which sheds light on exploring the design process and the modes of designers' mind-set. Soon various Design Thinking methods and approaches used by architects and urban planners were described by Peter Rowe's "Design Thinking" [17].

In the last few years design thinking methodology has been deeply rooted in architectural education and professional practice of architects and designers which was highlighted in several works [1, 2, 15, 18–22].

The ability of Design Thinking to become a powerful pedagogical tool has been already proved by a number of research projects such as The D-Think research project [18], Thinking & Acting Like a Designer [19], Design Thinking for Educators [15]. A number of scientists stress the importance of Design thinking for boosting collective intelligence, innovative thinking mindset, to form teamwork skills, empathy, and many other skills demanded from employers and organizations today [15, 18–20].

Tepavčević [1] considers model based and representation based design thinking approaches to be crucial for the evolution of pedagogical models in architectural education in the age of digital technologies.

There are several approaches to implementing design thinking techniques in the educational process. For example, Kowalewska and Sołtysik [2] have tested the three-step design-thinking educational model: a theoretical background lecture, "warm-up" activities and the problem-solving techniques. The first part includes demonstrating some theoretical information and practical aspects of contemporary design solutions for further inspiration for innovative ideas. The following "warm-up" activities with simple creative tasks were called to stimulate students creative thinking and to prepare them for the problem-solving [2].

An interesting approach was used by Polish scientists Tymkiewicz and Bielak-Zasadzka in their research on Design Thinking method in architectural design in the frames of Design Strategies coursework addressing present and future needs of senior people [21]. Their research has shown positive effect on students' creativity and innovative architectural solutions for senior people.

The combination of the Design Thinking Methodology and Role-playing was successfully applied by Stangel and Witeczek in education on brownfields regeneration. The positive results and a high level of students' involvement in the design process were noted by the scientists [22].

The conducted theoretical review has shown that the leading trends in architectural education today are based on the wide range of technological advancements and creativity which has caused the emergence of a large variety of new pedagogical approaches which are called to stimulate creativity and lead to better formation of future professionals in the sphere of architecture in relation to current job market tendencies.

The above analyzed scientific works demonstrate that the use of design thinking techniques at certain stages of design process has the tremendous potential for architects education.

However, there is not enough information highlighting the possibilities of using the methodology of design thinking throughout the whole project life cycle in architectural education - from problem statement and building empathy for potential users to project idea development, its prototyping and testing. In particular, there are no scientific papers on the introduction of design thinking in the Ukrainian practice of teaching architects, taking into account the local context and the problems of architectural education in Ukraine.

The above mentioned indicates the relevance of this study, in particular in the scope of Ukrainian practice of educating architects.

3. RESEARCH METHODOLOGY

The research methodology presented in the paper is based on two steps; literature review and case study. The initial stage of the exploratory investigation starts with literature review and structuring on different aspects of architectural education – its current stage, challenges and opportunities, innovative pedagogical models and trends, in particular the application of Design Thinking models.

The main part of author's investigation was based on developing the educational experiment based on application of the Design Thinking methodology in the course of "Theoretical and Methodological Basis of Architectural Design" discipline for the 3rd year students in the Institute of Architecture, Construction and Energy (IFNTUOG, Ukraine).

The final stage of the research was based on obtaining qualitative research data to investigate the level of satisfaction with the experiment as well as to reveal the local problems of architectural education from the students' points of view, taking into consideration their personal experiences, expectations and opinions. During the period of 2019–2020 years 51 students in total participated in surveys. The questions of the survey were aimed at evaluating the outcomes of experimentation course conducted by author, based on Design thinking approach.

In addition to the questionnaire, at the end of the semester the detailed discussion concerning not only the used design thinking methodology and main learning outcomes but also general problems of architectural education were raised.

4. CASE STUDY: INTEGRATING DESIGN THINKING METHODOLOGY FOR ARCHITECTS' EDUCATION IN UKRAINE. LEGO SERIOUS PLAY TECHNIQUE

4.1. The local context and course description

The current research case study was based on testing the Design Thinking methodology with the 3rd year students at the Department of Architecture and Urban Planning (Ivano-Frankivsk National Technical University of Oil and Gas, Ukraine) within the framework of the discipline: "Theoretical and practical basis of the architectural design". The need for such experiment was caused by several reasons.

The teaching staff of the department regularly follows the global educational trends and monitor the latest pedagogical approaches in architectural education. In local educational practice priority is given to the methods of conceptual design, creative sketching, imitation of the modern architects' ways of work, quick sketching and other methods of stimulating creative activity [12]. A great variety of pedagogical methods for training creativity on the basis of intuition, intensification of imagination, associative thinking and heuristic skills were tried by local educators with the aim to raise students' motivation and their interest in education. Nevertheless, in recent years, the decreased students motivation to learn and the general lack of creativity has become particularly noticeable.

The huge amount of students at the initial stage of working on the project face the same problem – lack of ideas. Sitting over the blank sheet of paper and seeking for inspiration, students often need support to facilitate their idea generation and design process. Indeed, students experience confusion throughout the design process, in particular at the stage of generating ideas [9].

One of the reasons for such situation can be found in technological progress, when students try to step over a creative idea generation stage and start 3D modelling immediately using professional architectural software. A parametric design method is applied at all stages [11], where all components have the potential to be transformed being a part of a whole. In these circumstances, the role of creativity in the professional development of a future architect is largely offset.

A possible solution to this problem was first seen by the author during the internship at Coventry University (United Kingdom) in 2019 in the frames of Creative Spark grant project. During the internship, the author has been participating in a series of workshops on innovative teaching tools based on the Design Thinking methodology. It was decided to implement this experience as an educational experiment in the local context in Ukraine in the framework of the discipline: "Theoretical and practical basis of the architectural design".

The theoretical component of the course was fully developed by author and included innovative topics relevant for future architects, such as methods of conducting sociological and architectural studies and their infographic representation, creative methods of designing and generating ideas, design thinking for architects, the use of new technologies in everyday work of architects and the development of architect's personal brand. Interactive playful learning, based on the design thinking methodology, and preparing students' group projects were selected for practical training.

The subject of student projects revolved around creative hubs, coworkings and summer creative spaces for students in the structure of university. This direction was chosen due to its special relevance for students. Students have deeply felt the necessity of solving these problems within different architectural and urban solutions connected with the current needs of young people in the era of disruptive innovations and new technologies, that caused the emergence of new work and leisure activities and modes of communicating with each other. Therefore, an attempt was made to address these challenges, applying design thinking tools in students' projects.

At the beginning of the course all students were randomly divided into small groups of 4 or 5 and each group was given the individual task, they had to work on together till the end of the course.

4.2. The application of the Design Thinking model in students' architectural design process

The classical Design Thinking model, developed by the Stanford D. School, was adopted for students' architectural design process [14]. This five-step model consists of 5 stages: empathy, define, ideate, prototype and test.

At the first "empathy" stage students were guided on how to build empathy through different interacting activities and participatory methods like interviewing for gathering insights from the potential users, to get a shared understanding of what the project should be.

Throughout this stage students had to observe what users do and how they interact with their environment and to capture different desires and needs of the people that will use the space. In most cases, when students don't have access to potential users, they need to imagine them [20]. Empathy is a core skill for architects to design good and successful projects, which can be accepted and used by other people. The "Empathy" stage was then followed by conducting empathy maps and sociological surveys within their colleges and students from other courses.

The next step was to define the problem. The right definition of the problem, which should be solved by architects, requires thorough synthesis of observations about potential users from the first stage in the Design Thinking process [14]. The "Define" mode of the design process aims to bring clarity to the design challenges students are taking on, based on the empathy for the person they are designing for and the information they have gathered about the user and the context. At this stage students created "Mind Maps" and participated in a number of brainstorming sessions, which were complemented by playful warm-up and ice-breaking activities. The aim of this stage was to define main problems concerning their projects and at the same time to develop students' creativity and prepare them for the next stage of the Design Thinking process.

During the "Ideate" mode students were focused on generating multiply solutions to address the problems defined previously. Idea generation is a process of transforming conceptual idea to concrete idea [6]. Being a combination of students' points of view, potential user's needs and endless possibilities of human imagination, ideation provides the valuable source material for creating prototypes and innovative solutions for the potential users..

The "Ideate" stage was conducted with the help of quick sketches method. Students were asked to draw an idea of their future project. Sketching methods form the basis for the development of individual creative method of the future architect in the ways of fixing and consistent implementation of the idea and its self-identification.

At the "prototype" stage, the ideas begin to come to life in the form of models (physical, digital, experimental). It is a quick way of visualizing and materializing ideas and concepts for further discussing with colleges and testing [7]. A prototype is any object that user can interact with: a sketch, a board with stickers for notes, a computer 3D model or a video tour, a simple model of foam and glue or LEGO bricks. The

more unusual material is used for prototyping the more creative results can be achieved.

In the fourth stage, taking into account the identified needs, the collected information about the user and generated ideas, students started working on the development of conceptual projects of innovative spaces in the structure of university. The "Prototyping" was first conducted with a help of Lego Serious Play technique and then followed by the 3d modelling tools.

The final "Testing" stage of the design thinking process aimed to get feedback from potential users and thus improve prototypes. Students presented their projects and discussed them with colleagues. The role-playing method was applied - students alternately played the roles of investors, future users and architects.

4.3. Lego Serious Play technique

In the process of the study the particular attention was paid to the application of the Lego® Serious Play® methodology (LSP) – a powerful facilitation tool used by organizations for involving employees in the generation of innovative ideas in an interesting and playful way [23]. It has also entered the field of higher education in recent years, showing fruitful results [24–26]. The classical Lego serious play workshop starts with posing a question which refers to the problem that needs a solution, after which each participant constructs his own understanding of the solution using Lego bricks. When the models are constructed everyone is welcome to share his model with other students. The final stage provides reflecting and discussing of the models, seeking for some key points, insights and connections [25]. The duration of an LSP session can vary and depends on the scale of the problem and the depth of its study.

In students' architectural design, the methodology can be widely used at all stages of the project work, including the problem definition stage, continue at the stage of generating ideas, formulating the concept of the designed building, its functional content, and be a successful tool for prototyping and testing project ideas.

The case study Lego workshop consisted of three phases that fostered the generation of ideas for new projects. Students were divided into groups of 8 to 10. In the first phase students were given a simple task to construct a Lego tower reflecting their personal attitude to the architectural profession. This task was endowed with an ice-breaking and warm-up function
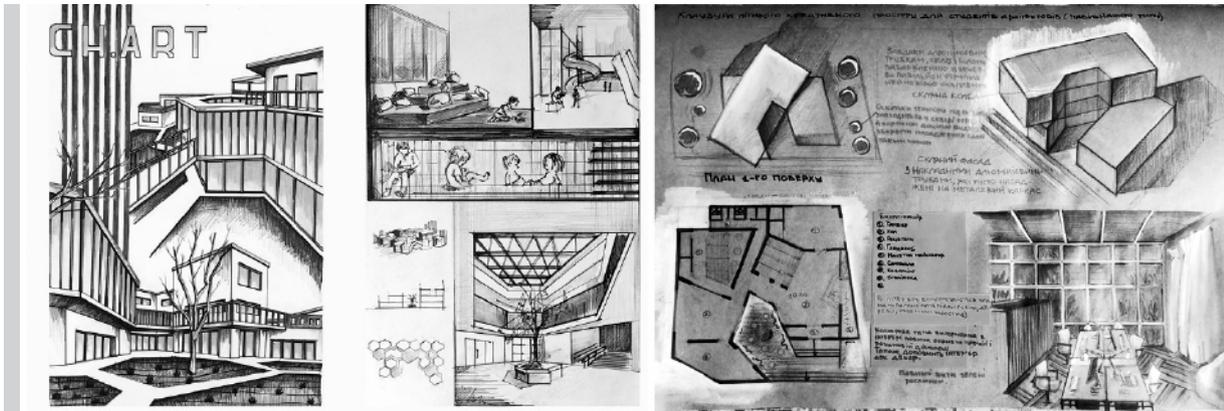
Figure 1.
Students' quick sketches at the Ideation phase (R. Snihur and V. Rudnytsky). Source: Author

to make the participants more relaxed and prepare them for the more difficult stage of idea generation.

After that the students were asked to build one aspect of their personal understanding of the concept of creativity and innovation. Each phase was finished with personal sharing of each participant's model and group reflection on it.

At the third phase students had to create a shared model reflecting the group understanding of how they see "The university space of the future". The insights they've received were soon reflected in their projects.

5. DISSCUSION AND RESULTS

Based on the outcome of each stage of the Design Thinking process, certain results were obtained.

The "Empathy" stage was followed by conducting empathy maps and sociological surveys within students. The results of sociological surveys taken by different groups of students had little differences but in general had shown the significant demand for coworking spaces in the structure of university. The process of sociological surveys was conducted by students in two forms – online using self-created questionnaires through Google form, and in the form of live communication with university students. Most of the questions concerned various functional and aesthetic desires for the architectural organization of the future coworking space in the university structure. The participation in survey of students of different specialties made it possible to obtain results from different fields. The students-architects paid more attention to the design and aesthetic aspects in their answers, and for the students of other specialties the functional aspects, various organizational and tech-

nological issues were important.

This variety of surveyed categories of students gave a more holistic and comprehensive view on the importance of different criteria that must be considered when designing a project.

During the "Define" phase the main problems identified by the students concerned the current state of organization of the educational and recreational environment for students in the university structure. Among the most pressing problems was the problem of the material base - all premises were outdated, in need of repair and technological equipment. Besides, the university structure doesn't provide any recreational facilities for students' rest, communication or work. Realizing the full depth of the identified problems, students received the boost to find the ways to solve those problems by means of architecture and design.

As a result of the ideation stage (Fig. 1) students have learned to concisely reveal the semantic, figurative and functional elements of the architectural concept, as well as gained professional skills on development and presentation of own project. This stage has enriched understanding the potential of the method of sketching, its role in professional work, students learned how to fully express in the sketch their individuality, idea, own values and artistic preferences.

The prototyping stage has appeared to be the most exciting for the students. Using Lego bricks, students have shown a wide range of original approaches to understanding the concepts of creativity and innovation and how they should be implemented in their future project (Fig. 2).

The main thoughts revealed in the following discussion were based on such features as innovativeness,

Figure 2.
The application of Lego® Serious Play® methodology. Workshop process. Source: Author
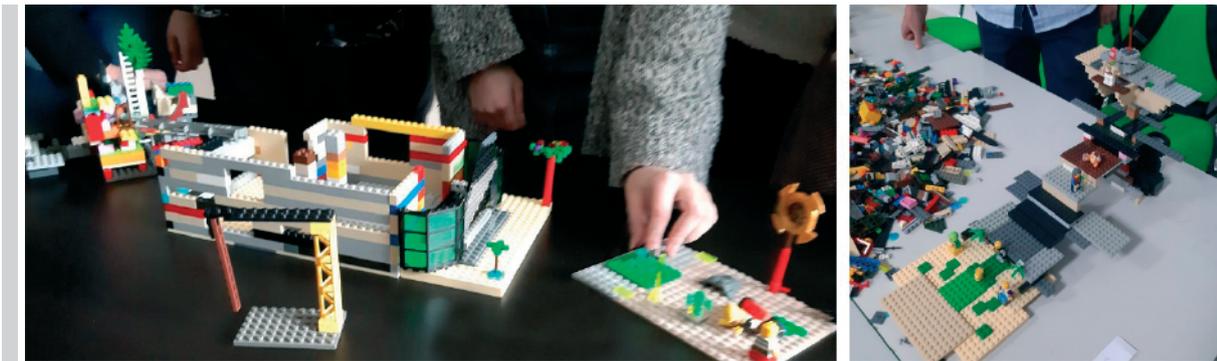

Figure 3.
The application of Lego® Serious Play® methodology. Building final shared models. Source: Author

accessibility, adaptability, creativity, openness; the future university space should be environmentally friendly, transformable, technologically equipped and modern. All these characteristics were totally reflecting students' needs in well equipped, creative and modern coworking space.

All the Lego models were placed on the table for further discussing within a group (Fig. 3). The experiment showed positive results – students were actively involved in the creative process, demonstrated original ideas and non-standard thinking both in individual and group building activities.

Testing has given another opportunity to gain empathy for the potential user listening carefully to his thoughts and impressions.

The application of role-playing method has shown a number of positive results – students were actively

involved in the discussion of each project, they were able to look at it from different points of view and have improved their skills of verbal communication and project presentation.

The biggest problem identified at this stage was the lack of verbal presentation skills. Future architects, who are accustomed to express their ideas in a visual way, felt insecure when presenting their projects to colleagues. The projects, collectively selected by students by anonymous voting, were subsequently submitted to the university administration and now are in the initial stage of implementation (Fig. 4).
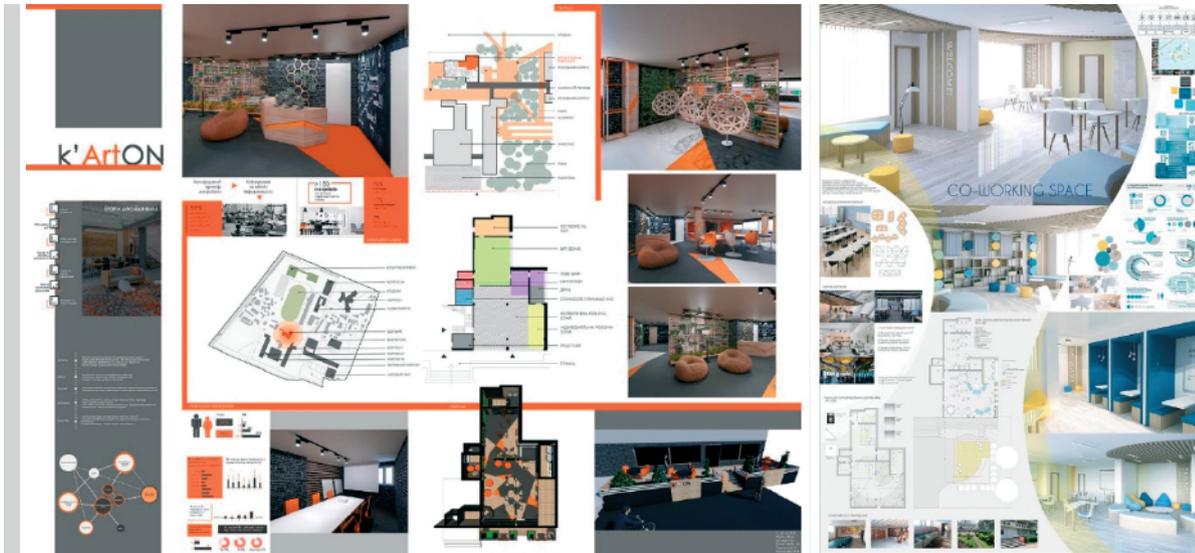
Figure 4.
The final students' projects. Source: Author

5.1. Students' opinion in questionnaires

At the end of the course, students were invited to participate in a survey to determine the level of students' satisfaction with the application of innovative pedagogical approaches as well as students' overall opinion about the course. During the period of 2019–2020 51 students in total filled the questionnaires. The questions of the survey referred to evaluating the outcomes of experimentation course "Theoretical and practical basis of the architectural design" conducted by author, based on Design thinking approaches.

The first part of the survey was aimed at revealing students' overall opinion about the theoretical content of the course. The results (Fig. 5) have shown fruitful and positive effects. The answers of the first part of the questionnaire ranged from "very low" to "very high" score. 92% of respondents express a high level of informativeness and novelty of the course, assessing its theoretical content with the highest score. 86% of students praised the direction of the discipline on the practical use of knowledge in the future profession. And 96% consider the course to be relevant in light of the latest research in the field of architecture.

The rest of the questions were aimed at identifying the advantages and disadvantages of using the methodology of design thinking in the educational process. 94% noted that the application of design thinking techniques has facilitated greatly their work on generating ideas for the project. 78% declared the possibility of applying this technique in future work on architectural projects. The most effective method of generating ideas from those used along the course, according to most respondents' thoughts, was Lego Serious Play, the second place is occupied by brainstorming. Mind mapping and sketching were the least interesting for the students.

Among the shortcomings identified during the application of the method, students noted the complexity of the method and timidity in expressing ideas to the public (for example in the process of discussing individual Lego models with colleges) and the complexity of the method.

In general, the results of the survey indicate a high level of students' interest in the discipline. A number of positive effects from the introduction of the design thinking methodology in the educational process should be noted, in particular:

- reducing the lack of creativity problem at the stage of forming conceptual ideas for projects;
- improving the quality of group interaction and teamwork;
- the formation of such important social skills as team building, leadership, time management, communication and creative problem solving.
- playful features of the method facilitate the perception and assimilation of theoretical information of the course;
- a simple and clear few-step technique of design thinking allows students to apply it in future work on their projects.
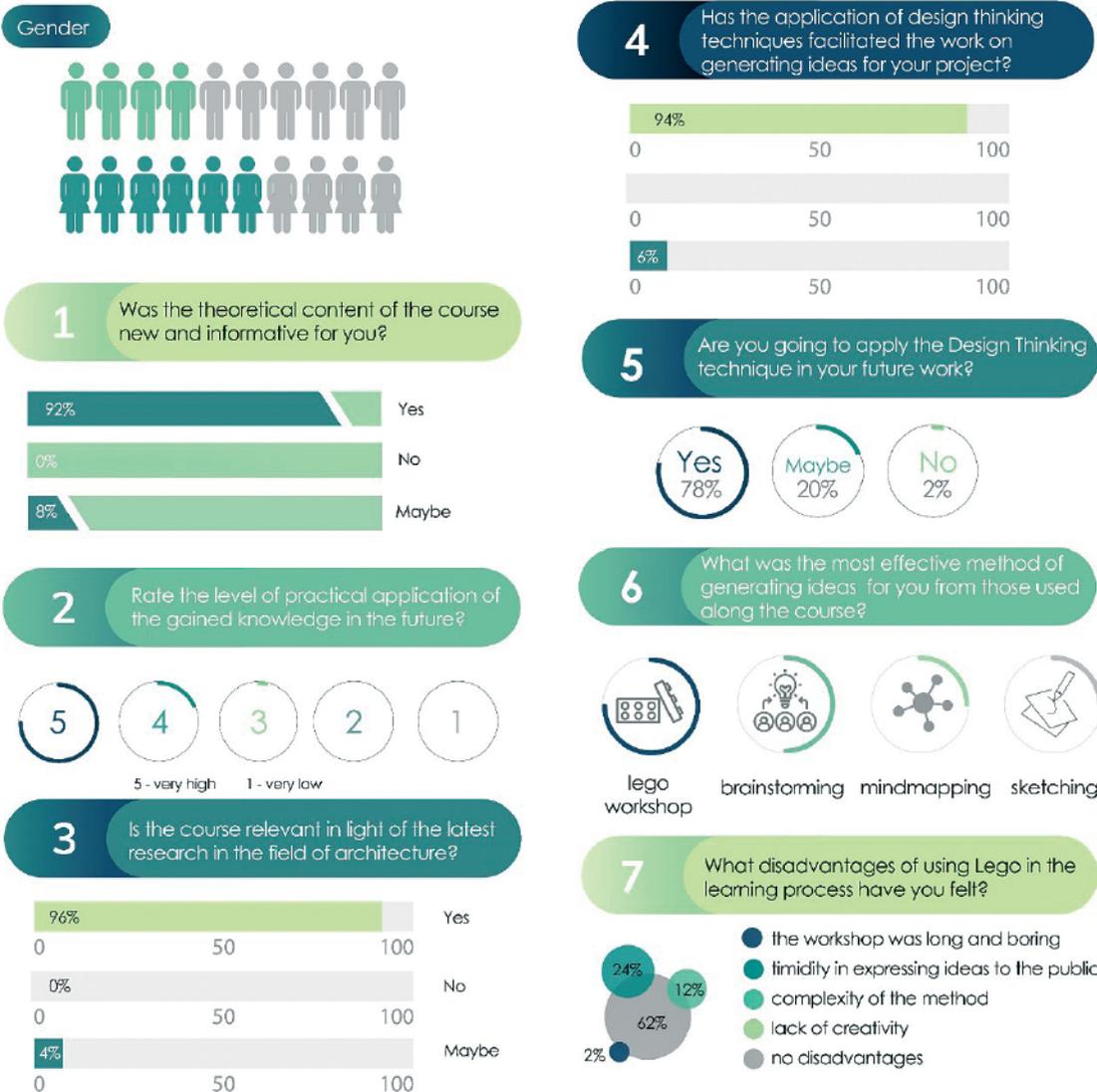
Figure 5.
Students' opinion in questionnaires. Source: Author

In general, the application of Design Thinking methodology with all its tools and approaches has transformed the educational process into enjoyable, interesting and highly effective learning experiences.

6. CONCLUSIONS

Fast-changing society, growing role of creativity and everyday innovations demand to reconsider classical pedagogical approaches in creative way and design innovative educational toolkit. Design Thinking methodology based on the powerful combination of empathy for the potential users, creativity in producing ideas and solutions, and the ability to prototype and test those solutions in the real context, has an amazing potential to become a necessary educational tool. Possessing powerful creative and team-building properties this human-centred methodology should be used as a helpful tool to rethink not only peda-

gogical approaches but also the organization of creative learning environment and a valuable mind-set to meet the challenges of a new educational paradigm. Technology innovations in the digital age have profound impact on design thinking in architecture and especially in architectural pedagogy for the new generation of architects.

Despite the fact that the development of technology can have a negative effect on the creative skills of architects, the design thinking technique provides opportunities to use technological advances for its own benefit. The recent development of information technologies has improved the existing tools and methodologies for prototyping and testing in architectural education. For example, VR technologies are more often used in architecture – both in educational process and in professional practice, demonstrating VR presentations of projects to clients. "Walking through" designed virtual building, students can interact with them, exploring different functions of future space, in such a way testing their own projects and revealing possible mistakes. The possibility of integrating innovative technologies with the Design Thinking techniques in architectural education has a great potential to be further investigated.

ACKNOWLEDGEMENTS

FUNDING

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