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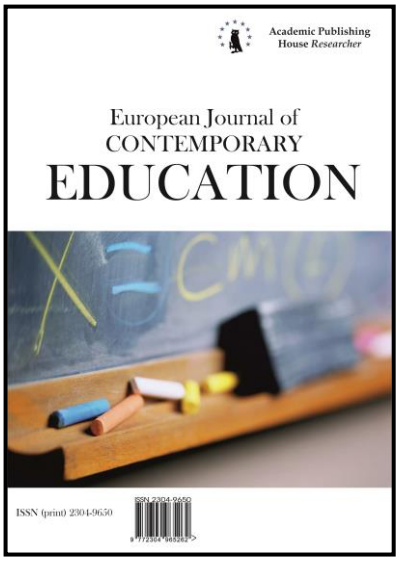

Cultivation of the Skills of Design Thinking via the Project-Based Method as a Component of the Dual Model of Learning

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Abstract

This paper outlines some of the key changes to cultivating relevant capabilities, skills, and competencies that are expected of university graduates today. Transformation processes in this area are calling for the creation of a relevant system of workforce education and training, with a focus on optimizing the conditions for combining work and training. This issue could be resolved via a set of activities on developing special models of mutually beneficial relationships between educational institutions, employers, and stakeholders. Such activities will be aimed at ensuring the practical preparation of education seekers for independent professional activity and their social adaptation in work teams, proper regulatory-legal and organizational support, the conduct of testing, the conduct of research, the fine-tuning of such models, and the development of recommendations on the use of such models on a wider scale.

The dual model of learning, currently regarded by many as quite successful, combines effective innovative techniques and methodologies, including those founded on the project-based method. Through the example of the experience of several Ukrainian universities, specifically Sumy State University, with respect to the conduct of project-based activity, the authors describe the role of this type of activity in fostering the skills of design thinking with a focus on streamlining the experience of engaging in project-based and research activity.

The authors' calculations using the Pearson correlation coefficient and the F-test helped establish that how many projects will be undertaken does not directly depend on the number of project groups.

Keywords: design thinking, innovation-focused pedagogy, project-based method, dual model of learning.

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1. Introduction

The purpose of just about any educational program is to provide students with general scholarly and professional-practical training that will enable them to perform confidently a set of professional duties in a certain field, guarantee their being sought after and competitive in the labor market, and provide broad vistas for self-actualization in their profession, further education, and self-education. It is hardly possible to achieve this objective in the conditions of today without supplementing basic theoretical training with high-quality practical training delivered to students through engaging them in direct activity in a company in their field – both as a volunteer and as a participant in a joint project via an agreement.

Formal training provided by universities and practical on-site training in a company in one's field could be combined via the use of the dual model of learning, with a focus on fostering design thinking, including via the project-based method. Given that many universities around the world have lots of positive experience in this area, the approach merits close study and adaptation across the global educational environment.

One of the author's previous works examines some of the latest challenges and trends in the development of the labor market and discusses the need for implementing in the educational process special methodologies and mechanisms for fostering systems thinking – as a crucial element of general scholarly and media education and a must-have skill in light of today's economic realities (Lebid, Shevchenko, 2020). In this regard, it is worth noting the fact that most present-day universities strive to react to challenges and emerging trends by streamlining their programs and courses in keeping with changes taking place around the world.

The professional world is constantly developing, and today this evolution is largely spurred by advances in technology. Despite this, today's emerging skills are more about emphasizing innately human capabilities (e.g., those related to thinking, communication, leadership, etc.) than manipulating machines.

With this in mind, most major universities are interested in fostering and developing "elemental" capabilities and skills in their graduates (e.g., systems analysis and evaluation, creativity, originality, and initiative, technology design and programming (Harvard PD, 2020), time management and learning strategy development, planning, design, analysis and examination skills (DCE, University of Oxford, 2020), intellectual skills, communication skills, and organization and research skills (SP, University of Cambridge, 2020; PSMs, Yale University, 2020).

The above list of capabilities and skills for modern-day university graduates reflects the actual situation with the system of professional and general competencies today, when it is no longer sufficient to focus on conventional models of knowledge management and there is a need to foster the skills of subject-to-subject interaction, with design thinking appearing to be one of them.

Design thinking implies the use of creative techniques, the ability to ask questions and work in a team, being interested, optimism, being oriented toward people, and the ability to generate new solutions and come up with creative ways of accommodating the needs of other people, companies, educational institutions, and society as a whole. Design thinking can help the subjects of the educational process detect and resolve problem situations during the process of learning.

2. Materials and methods

In conducting the research reported in this paper, the author analyzed curricula and syllabi in and across specific disciplines and core competencies to be mastered by graduates of some of the world's top universities (e.g., Harvard, Oxford, Yale, Cambridge, etc.). The author examined the development of such competencies through the lens of using the project-based method in pedagogy with a focus on employing unconventional, creative, and innovative approaches to fostering design thinking in students.

A key component of this study is the following key principles of the dual model of learning:

– a focus on practice-oriented learning;

– the use of active forms of organizing the educational process;

– the use of innovative pedagogical technologies;

– a focus on subject-to-subject pedagogy, built on a model of partnership between students, instructors, employers, and stakeholders;

– a wide use of practical cases in the educational process;

– a focus on problem-based learning.

Each of the above items encompasses several crucial areas of work focused on resolving issues of an organizational, communication, pedagogical, and instructional nature in a stage-by-stage manner.

In addition, the study employed methods of statistical analysis of quantitative data and statistical methods of data processing, specifically computing the Pearson correlation coefficient and using the F-test to assess statistical significance.

3. Discussion

The development of design thinking has been the subject of extensive research. The key areas of this research include the following: employing design pedagogy methodologies in teaching the fundamentals of entrepreneurship (Sarooghi et al., 2019), exploring design thinking as a sought-after skill for future engineers (Soboleva, Karavaev, 2020) and health and medical workers (Badwan et al., 2018), and exploring design thinking as the basis of interactive group learning (Woolard, 2018; Clemmensen et al., 2018).

A separate group of research works is represented by research into the use of the project-based method in pedagogy and in the process of fostering design thinking. Elsewhere, one may find some interest in research into procedural knowledge of project-based activity (Chon, Sim, 2019) and research that places project-based activity in the context of developing a strategy for development (Ben et al., 2016).

Scholar G. Lutsenko, who has analyzed the current condition of Ukraine's system of engineering education, has noted the prevalence in it of traditional pedagogical approaches, whilst many universities are currently employing the problem- and project-based learning model, with a focus on fostering in a person the capabilities and skills that are the most sought-after in the labor market today (Lutsenko, 2018).

In this context, it is worth noting that Ukrainian universities are gradually joining in and starting to adopt some of the globally recognized practices for organizing the educational process factoring in the latest trends. One such institution of higher learning is Sumy State University. This college has built a system of administering, organizing, monitoring, evaluating, and analyzing the educational process based on the principles of dual learning, which has helped it achieve high positions on various international rankings (e.g., Times Higher Education World University Rankings, QS World University Rankings, Webometrics Ranking of World Universities, U-Multirank, SciMago Institutions Rankings, Shanghai Ranking, etc.).

Scholars S. Bećirović, F. Hodžić, and A. Brdarević-Čeljo have stressed the need to foster in students a set of soft skills, particularly critical thinking skills. The findings from a research study conducted by this group of researchers are suggestive of the need to overhaul existing curricula and teaching strategies to bring them in conformity with the latest educational standards with a view to implementing and expanding methodologies and approaches that can facilitate the development of soft skills and critical thinking skills (Bećirović et al., 2019).

Today, there is a growing need for a workforce that has the ability to not just analytically respond to routine tasks but also employ unconventional algorithms to resolve them, which, as suggested by a study conducted by scholars H. Sarooghi, S. Sunny, J. Hornsby, and S. Fernhaber, involves the use of the skills of design thinking. According to this group of researchers, while entrepreneurship education *has* embraced a design thinking lens, as evidenced by the increasing number of curricula incorporating processes that have roots in design, there remains limited understanding of the conceptual underpinnings and the implementation of such practices (Sarooghi et al., 2019).

The need to foster design thinking as a special type of thinking has been pointed out by scholars E. Soboleva and N. Karavaev. In their view, this type of thinking is based on problem-solving and cognitive activity and aimed at solving socio-economic problems in the climate of the Fourth Industrial Revolution and amid the rapidly evolving digital economy. The researchers draw the conclusion that there is a need for putting in place a set of university courses with special interdisciplinary project-based forms of activity, which should create additional conditions for cultivating key capabilities, skills, and professional competencies in training specialists who will be sought after in a digital economy (Soboleva, Karavaev, 2020).

Today, there is little doubt that the priority is with the use of innovative approaches in education, promotion of teamwork, and development of group assignments and practical cases.

In this context, scholar N. Woolard sets great store by design pedagogy for the benefits it offers by way of interactive learning and working in small groups, with a focus on employing in the educational process the adaptive leadership model (Woolard, 2018).

In the view of researchers B. Badwan, R. Bothara, M. Latijnhouwers, A. Smithies, and J. Sandars, "design thinking provides a creative and innovative approach to solve a complex problem". The scholars are convinced that design thinking can help one "acquire essential transferable life-long learning skills", and suggest that the approach can be widely applied in medical education, from technology intervention projects to curriculum development (Badwan et al., 2018).

Scholars T. Clemmensen, A. Ranjan, and M. Bødker note in their study the growing trend of co-creation and co-design in cross-cultural design teams. The researchers integrate design thinking with the dynamic constructivist theory of culture to propose a situation-specific framework for the empirical analysis of design thinking in cross-cultural teams. The study's results provide some insight into how cultural knowledge shapes core design thinking in specific situations (Clemmensen et al., 2018).

Scholars D. Henriksen, S. Gretter, and C. Richardson suggest that, while design thinking is currently receiving increased scholarly and popular interest in education, teachers are often uncertain about how to implement it in their educational settings. The researchers, nonetheless, are convinced that design thinking offers a sound framework to address the challenging problems of practice educators get to face. In their article, the scholars share how the use of the Stanford Design Thinking Model in a graduate-level teacher education course helped the participants creatively solve problems of practice relevant to their context, with the following three main takeaways from the experience reported: (1) valuing empathy; (2) becoming open to uncertainty; (3) seeing teaching as design (Henriksen et al., 2020).

In the view of researchers D. Chin, K. Blair, R. Wolf, L. Conlin, M. Cutumisu, and J. Pfaffman, design thinking is one of the best tools for equipping "students with learning strategies they can apply when approaching new problems on their own". The study's findings indicate that design-thinking strategies are good for both curricular and extracurricular work. It is suggested that design-thinking instruction may improve the likelihood of lower-achieving students choosing to use effective strategies in novel settings that require new learning (Chin et al., 2019).

According to scholars H. Chon and J. Sim, the "process of design explicates the procedural knowledge of design activities, shifting theoretical conceptions across practical dimensions". The researchers note that this creative and innovative methodology is the result of research into implementing design thinking in the pedagogical process, which has established it as a designerly process for non-designers to address complex problems and generate new knowledge. The use of the design thinking methodology as the basis for decision making in design research and practice implies inducting students into an interdisciplinary project. The scholars suggest that the "perspectives and insights arising from the collaborative, design thinking methodology are extracted, analyzed, and adapted to form a framework to illustrate the non-linear, circular structures of knowledge generation from theory (designerly knowing) to practice (design thinking) and research (design knowing)" (Chon, Sim, 2019).

An obvious fact today is that standard approaches to project management are ill-suited to address changes in the environment or business needs, particularly in innovative contexts characterized by uncertainty and complexity. In the view of scholars M.-J. Ben, C. Midler, and P. Silberzahn, instead of being concerned with the efficient implementation of a deliberate strategy, a project in such a context becomes a process for strategy formulation, with the following three imperatives for project management arising as a result: (1) managing the explorative phase; (2) managing the involvement of stakeholders in the project; (3) managing the project in relation to the firm's strategizing process. The researchers suggest that design thinking can make a number of important contributions to these imperatives (Benet al., 2016).

Thus, project-based and design thinking have been recognized by the scholarly community and practitioners as a new methodology that can be efficient in innovation activity in the areas of research, management, and teaching.

4. Results

In recent years, design has transformed from a tool that helps boost consumption into one that helps create new values by way of innovative projects and solutions with a view to simplifying and humanizing a product or service. One of the first scholars to bring up the interdisciplinary nature of design thinking was R. Fuller (Fuller, 1997). In the late 1960s, scholar H. Simon proposed an anthropocentric doctrine of design thinking – rapid prototyping and testing through observation (Simon, 1996). Scholar D. Norman invokes the participatory design approach, which emerged in Scandinavia, to propose an improved formula for it – user-centered design (Norman, 2013). In the view of V. Papanek, it is hardly possible to achieve high quality, effective design without the use of anthropological research (Papanek, 1973).

Thus, so far the following key principles of design thinking have been formulated: interdisciplinarity, prototype creation and testing, anthropological research into consumer needs and wishes, and designers' social responsibility.

Worthy of special mention is the Hasso Plattner Institute of Design at Stanford University, with its mission statement – 'We believe everyone has the capacity to be creative. The Stanford d.school is a place where people use design to develop their own creative potential'. D.school is a platform for researchers and experimenters engaged in the development of one of today's most sought-after skills – a capacity for systems and creative thinking.

Thus, design thinking is a method for creating products and services oriented toward a person, a process that implies taking account of a person's values, needs, motivation, and problems. Design thinking is a mode of thought and a worldview oriented toward creativity and innovation. The key purpose of design thinking is to generate new solutions and come up with creative ways of providing for the needs of others in an efficient manner.

Design thinking is distinguished from other methods in a number of ways. Firstly, it is its orientation toward a person. Secondly, it is its focus on creative cooperation. Design thinking encourages teamwork and ideas exchange in a format of interdisciplinary discourse. Thirdly, it is its focus on experimentality and optimism. There is nothing wrong with making mistakes occasionally, as long as you learn from them. Indeed, involvement in unconventional situations may lead to valuable insights and unexpected solutions. Fourthly, it is its non-linearity. Design thinking is non-linear and highly flexible, despite being structured in a logical manner in the process of looking for solutions to unconventional problems.

Today, design thinking is employed across a wide spectrum of activities, including social entrepreneurship (e.g., Clean Team, Marc Koska's K1, etc.), business (e.g., Vlisco, MRI scanning for children, etc.), nongovernmental organizations (e.g., Jerry Sternin's project, Vroom, etc.), the public sector (e.g., The Good Kitchen, live|work, etc.), etc. The design thinking method appears to work most efficiently in the area of interdisciplinary research, projects, and initiatives.

In addition, today design thinking is used widely in pedagogical practice. While this method is primarily used in business to gain insight into clients' needs, with a focus not on imposing your own vision on them but on taking account of their needs, education is a service too, with many instructors tending not to concern themselves with the wishes and needs of the client – the student. In this regard, the key objective behind design thinking is to replace the subject-to-object pedagogical model with the subject-to-subject model, which implies relationships between equal partners. There appears to be a need to renounce paternalism in teaching and encourage empathetic communication between the teacher and the student. As a bottom line, there is a need to engage the student in the decision-making process.

Today, subject-to-subject pedagogy is not only about a partnership between the teacher and the student but also about cooperation with the employer and the stakeholder. This triune synthesis should help develop effective educational strategies and programs. The potential for this type of dialogue is there, and it can be exploited via the dual model of learning.

The classic version of the dual model of learning combines university study and workplace learning, with a focus on acquiring relevant skills and competencies. The fundamental principles of the dual model of learning are an increased study load to be completed in the workplace, employers taking a direct part in the development and coordination of educational programs, in the implementation thereof, and in the assessment of students' academic progress, and students performing bespoke research work for employers.

Today, the proper fulfillment of the principles of dual learning is possible only through taking a systems approach to organizing the educational process. In a system of this kind, a proper place and appropriate functions ought to be reserved for education authorities, government and local authorities, companies and organizations (i.e., potential customers for a workforce), various territorial communities, non-governmental organizations, professional associations, and other entities.

The existing practice of implementing the dual model of learning in universities attests to a focus on systemicity in implementing this type of educational practice and helps identify some of the key components of specialist training via the dual model, which are as follows:

– a close link between theory and practice, with the practical component being a mandatory part of the educational process;

– the use of active forms of organizing students' academic work and innovative pedagogical technologies;

– the availability of flexible work and class schedules, which are coordinated with the companies or partner organizations to enable the holding of practical classes at them;

– an opportunity to explore in practical classes specific situations and cases from the experience of partner organizations and then reenact them on site;

– a partner organization taking part in the development of curricula and the subject matter of term and diploma papers;

– student performance being evaluated by a company serving as a practical training base, which enables prompt reacting to the needs of the labor market and helps make the educational program flexible, mobile, and effective;

– students engaging in real communication with the target groups, which enables them to acquire, alongside relevant professional qualifications, a set of crucial social and communicative competencies, which should help them build a successful career in the future.

Specifically, the above-mentioned technologies associated with the dual model of learning involve cultivating systematic cooperation with employers in terms of ensuring proper practical training and enhancing the substantive part of educational programs, as well as orienting the universities toward the use in pedagogical activity of innovative technologies and approaches under a flexible organizational and management structure that will be capable of taking up and supporting innovations and reacting promptly to the changing conditions and needs of the labor market.

With that said, it is worth noting that the effectiveness of the system of dual learning is ensured via the consistent and systematic implementation of the above-mentioned fundamental approaches and principles and is the combined responsibility of all participants in the process.

It follows from what was said above that one of the foundations of the dual model of learning is the project-based method, which aims to engage the seeker of higher education in the real processes of their professional growth. The author views the use of project-based activity as not just a way to keep pace with current trends but as a real and powerful tool for ensuring the practical training of specialists. Engaging students in project-based activity appears to be crucial from a standpoint of fostering in them both professional and general competencies.

Systematic work with employers and training bases is an indispensable condition for engaging students in project-based activity. It helps select for each student, within the frame of studying particular disciplines, just those forms of work and tasks within the frame of a project's topic that are interesting to them, lend themselves to implementation, can be objectively assessed, and will potentially be useful in the graduate's future professional activity.

At the same time, the author does not view engaging students in project-based activity only as a way to fulfill the practical component within the frame of particular disciplines that are oriented directly toward this kind of activity. Of utmost significance is engaging students in project-based activity throughout the period of study, with approaches of this kind being particularly significant within the frame of the implementation of the dual model of learning.

Project-based learning is an effective and relevant approach to teaching and learning. Implementing it in the pedagogical process helps enhance student motivation for learning and raise the level of student achievement. On one hand, the use of the project-based model helps implement a program of early career guidance for students, and, on the other hand, it helps cultivate and reinforce through practice the professional capabilities and skills a university graduate must possess.

Since learning is a social activity, through project-based learning students can not only put their knowledge of academic disciplines to actual use but also learn to negotiate, make joint decisions, take responsibility as a teammate, and interpret the outcomes of their activity in a collective manner.

This also helps develop a student's innate intellectual abilities via the use of unconventional, innovative approaches. A key benefit of using the project-based approach in learning is that project-based learning is implemented through interdisciplinary linkages that extend beyond the scope of a particular academic discipline. This helps expand significantly the potential for participants in the educational process, facilitating boosts in creativity and the acquisition of crucial practical skills.

Projects, which are different from each other in orientation, level (local, regional, national, or international), subject matter, duration, or funding, could provide, based on effective organizational and instructional work, a foundation for quality academic work and creative activity on the part of students and significant potential for serious independent work.

On the instructor's side, this work includes continual monitoring of relevant resources; preparation of a suite of possible projects; organization of work on preparing project applications; keeping track of the characteristics of academic disciplines and employing relevant interdisciplinary approaches so as to achieve maximum effect in fostering student competencies.

In a general sense, student project-based activity is a lot broader than the traditional spectrum of communications and is oriented not only toward the academic community but toward the public sector, government and local authorities, and international organizations as well.

To summarize the experience of Sumy State University, within the frame of various disciplines and in different years of study students are engaged in project implementation at different levels and are given different objectives. For instance, first-year students receive simple assignments, like familiarizing oneself with the activity of a center or a nongovernmental organization, taking part in a special event or a flashmob, or organizing one, analyzing one's own experience and experiences, analyzing the reaction of other participants, etc.

The next stage involves working on tasks that are somewhat different in nature, with students not only immersing deeper into the idea but testing particular technologies as well. This kind of "immersion" is particularly useful in working on the practical part of one's term assignment. Students can also get a handle on implementing the monitoring component of projects via relevant problems within the frame of various courses. Problems of this kind may deal with assessing particular stages of a project from the side of a target group, taking part in the conduct of focus-group research, taking part in the collection of statistical data, etc. In the senior years of study, the curriculum may include term assignments on project management with a view to consolidating, systematizing, and complexifying one's skills through a more complex instrumentarium for project-based activity. It is for this reason that it so important for a university and its departments to develop a suite of active projects on various topics and for various target groups.

Engaging students in project-based activity within the frame of the dual model of learning involves the conduct of systematic organizational-instructional work. This is about organizing the logic behind the curriculum and working out relevant educational programs with a focus both on having them cover fundamental theory and on linking their content with specific training bases and their active projects, with a view to helping one develop a set of professional competencies and skills crucial to the development of one's own projects.

Thus, the project component is one of the key factors in modern-day education. Evidence from experience suggests that engaging students in project-based activity helps foster and develop in them the skills that most employers look for in their candidates. A good example to illustrate this is the fact that, under the aegis of the International Foundation for Electoral Systems (IFES), in 2019 eight and in 2020 14 more Ukrainian universities joined a special program designed to teach an integrated course named 'Democracy: From Theory to Practice', which mandatorily involves the implementation of a student project.

As part of a project, students explore a problem faced by a specific target group. To investigate it as thoroughly as possible in order to determine its causes and resolve it, they develop an appropriate action plan. This process consists of several stages. Students get to examine each of the course's topics in the context of the problem selected for study, with a focus on addressing issues of the following kind: determining whether a problem has to do with human

rights and suggesting possible ways to resolve it, determining the responsibility for a problem on the part of the authorities and suggesting possible ways to resolve it, determining the role that could be played by civil society in resolving a problem, suggesting possible ways for citizens themselves to resolve a problem, etc.

In the context of said course, the author visited over 10 workshops designed to test various interactive learning methods, explore various algorithms related to project-based activity, and gain an insight into the key components of project-based activity, and that is considering that the author already had an appreciable amount of experience in project-based activity.

To support the idea that the system of student project-based activity has really worked in Ukrainian universities, it should be noted that during the spring term of 2020 the Democracy: From Theory to Practice course was attended, according to IFES, by as many as 959 students. Each student project was handled by a group of four to six students, i.e. as part of the course nearly 190 projects on various topics were implemented (Table 1).

Table 1. Student Project Subject Areas (Ukraine)

	Project subject area	Total number of projects, %
1	Charity; aid for orphaned children	2
2	Countering corruption	5
3	Countering bullying; preventing school violence	5
4	Protection of human rights	10
5	Promoting healthy lifestyles	4
6	Inclusion	11
7	Media literacy	3
8	Conducting public hearings	1
9	Countering domestic violence	10
10	Countering juvenile crime	11
11	Youth participation in elections	9
12	Financial literacy	2
13	Fostering active citizenship among the population	18
14	Environmental protection	9

While by no means an exhaustive list of student projects, it does reflect some of the trends, issues, and interests common to young people today. Note that a student project is not exclusively of a descriptive nature – on the contrary, it implies organizing specific activities, including all kinds of events, aimed at creating a stir among the general public, drawing attention to various social issues existing in society.

Based on the total number of students who took the Democracy: From Theory to Practice course and were engaged in project-based activity, the author calculated the total number of potential project groups, including through the lens of their gender characteristics in the context of both all the Ukrainian universities where the course was offered and Sumy State University in particular.

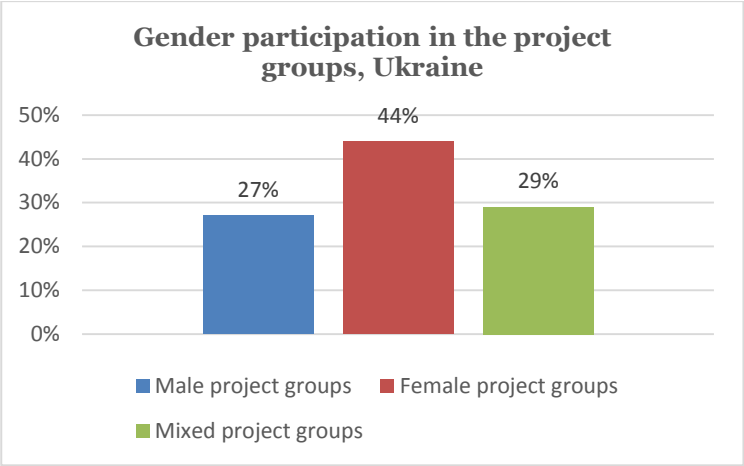

Fig. 1. Gender participation in the project groups (Ukraine)

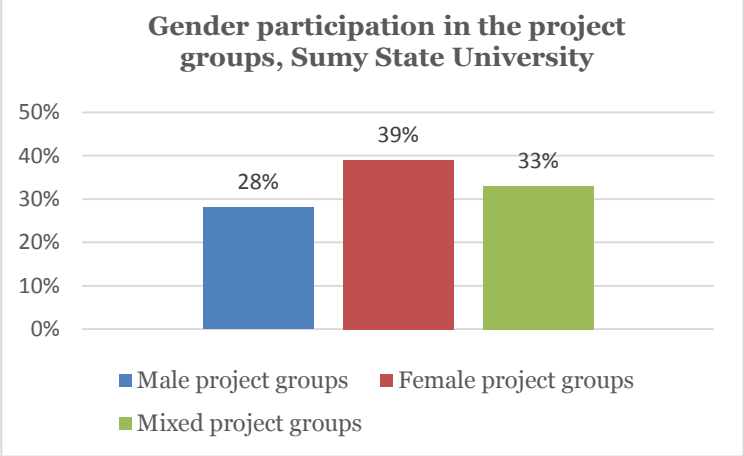

Fig. 2. Gender participation in the project groups (Sumy State University)

To determine the discrepancies between the empirical (observed) and theoretical (expected) frequencies, the author analyzed the performance of project teams at Sumy State University in the fall term of 2019 and the spring term of 2020, which is when the Democracy: From Theory to Practice course was actually taught, with a student project implemented as a mandatory part of it.

Based on the number of students who attended the course during said period, the author calculated the total number of project teams and potential projects undertaken by them on the assumption that one project group undertakes one project (Table 2), and computed gender participation in the project groups (Figure 2).

Table 2. Number of Project Groups (Sumy State University)

	Male project groups	Female project groups	Mixed project groups	Male project groups	Female project groups	Mixed project groups
	Results observed			Results expected		
Year 2019	13	21	17	14	20	17
Year 2020	11	13	12	10	14	12

To determine statistical significance, the author used the non-parametric χ2 test. The following hypothesis was formulated: H_o – the number of projects undertaken does not depend on the number of project groups. The following formula was used:

$$\chi_n^2 = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E_i}$$

The calculations produced the following values: $\chi^2 = 0.292$ and $p = 0.865$. Comparing the latter with the standard value ($p = 0.05$) leads to the conclusion that we cannot reject the null hypothesis, as the results do not satisfy the condition $p \leq 0.05$. Thus, it turns out that there is no direct relationship between the number of project groups and the number of projects undertaken by them, as one project group could undertake between one and several projects or it could undertake no projects whatsoever. Note that such cases *did* take place.

Moreover, there were cases of students engaging in no projects whatsoever, as well as cases of a project group being formed but failing to formulate its project's topic and then implement it. There were cases of project groups being reformatted or dissolving themselves, with their members exiting of their own accord. In the end, these factors had an effect on the quantitative results and their analysis.

A question of interest is to see which is the most popular project topic across the project groups and if there are purely "male" or purely "female" projects out there. Based on the findings from the author's analysis, such a division does exist (Table 3).

Table 3. Gender Preferences in Terms of Project Subject Area (Ukraine)

Project group	Project subject area
Male project groups	1; 2; 7; 8; 12
Female project groups	3; 4; 6; 9; 14
Mixed project groups	5; 10; 11; 13

Comparing the data in Table 1 with that in Table 3, it can be seen that the male project groups were mainly focused on working on Project Topic 1 (2 % of the total number of projects), 2 – 5 %, 7 – 3 %, 8 – 1 %, and 12 – 2 %, i.e. a total of 13 % of the total number of projects. Similar calculations were performed with regard to projects implemented by the other two project groups, with the female project groups implementing a total of 45 % of the projects and the mixed ones – 42 % of the projects.

In this context, it is possible to speak of the calculations being somewhat tentative and variable, as there were dynamic differences in the project groups' preferences in terms of project subject area. However, these deviations were within the measurement accuracy, so they did not affect the experiment's integrity much.

Of interest is the fact that different project groups chose different formats of conducting a project activity, with the male groups tending to employ monologue-based types of activity (e.g., information distribution, public lectures, presentations, etc.), and the female project groups tending to utilize more interactive, dialogue-based, forms and methods (e.g., flashmobs, workshops, advocacy, facilitation, etc.).

The answer to the question 'What is to be done to develop the skills of design and project-based thinking?' is obvious – 'to study and to practice them'. The process of learning and fostering these skills is what student projects are all about.

5. Conclusion

Design and project-based thinking is a methodology for generating innovations that is being keenly used today by Google, Apple, Samsung, and other major companies. It is about speeding up communications in a team and structuring the processes of generation and implementation of ideas. What is central to this methodology is ensuring an optimal user experience from interacting with a product or service. With that said, the physical parameters, mainstream to most of us, are secondary here, although they are still quite important for the user experience.

The present-day education system is shifting from the traditional model of the teacher transmitting information to the students to a focus on cultivating essential skills and competencies sought after in today's world. This includes developing the skills of working in a team, fostering emotional intelligence, and cultivating the skills of critical and creative thinking.

The use of design thinking in project and research activity facilitates the development of many crucial skills, and is the result of a person gaining experience during the process of solving problems. By teaching children design thinking, we can start preparing them already today for their future innovation-focused activity.

The author's calculations using methods of statistical analysis and data processing helped draw the conclusion that the significance level value alone will not tell us anything about the probability of the null hypothesis being true. The p value is always computed assuming the null hypothesis is true. Of importance is also the fact that, if $p > 0.05$ (5 %) and H_0 is not rejected (as is the case in this study), we cannot state so unequivocally that there are no differences. They could have been there, but we were unable to find them with our sample – there might be a problem with the actual sample, with the way it is designed. The results confirm the hypothesis that the number of projects does not depend on the number of project groups, which is supported by an analysis of the data in Figures 1, 2, and Table 3.

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