DESIGN THINKING AND PROJECT-BASED APPROACH IN LEARNING

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ДИЗАЙН МИСЛЕНЕ И ПРОЕКТНО БАЗИРАН ПОДХОД В ОБУЧЕНИЕТО

Abstract

This paper explores the concept of user experience (UX) and terms related to UX design. It emphasizes design thinking as a key concept, outlining its main characteristics and the most common models. The goals to be achieved through the use of the project-based approach in web design education are defined. The application of design thinking through the use of prototypes in project-based learning develops creative and critical thinking skills and represents an important aspect of modern education.

Keywords: *Design Thinking; Project-based Approach; User Experience (UX); UX Design; Interaction Design (IxD); Usability Testing; Prototypes; Learning.*

INTRODUCTION

In the dynamic world in which we live, we are presented with the challenge of adapting to it and making changes in education to meet the needs of society. The future fulfilment of students is now unthinkable without key skills such as creativity, critical thinking and innovation. Change in traditional pedagogical models of learning is inevitable and different approaches are increasingly being applied both alone and in combination, changing the focus of teaching. Among those that stand out and are finding increasing application in education are design thinking and the project-based approach.

In this study these two approaches are discussed in detail. An overview is given of the emergence of design thinking – what its definition is, how it emerged as a concept and how it has developed over the years. The main and most widely used models of design thinking and their phases are presented, as well as their common characteristics – empathy, cyclicality, creativity, criticality, prototyping and their testing and collaboration. Its core concept is the human-centred approach, where the needs and desires of users are paramount. In the context of education, design thinking encourages students to emerge as designers who in the process learn to develop empathy, define problems, generate ideas, create prototypes and test them.

The essence of the project-based approach is discussed in detail, as well as its key characteristics – focus on real cases and problems, interdisciplinarity, the active role of students, the role of the teacher as a mentor, teamwork, getting feedback and creating a final product. Students play the main role in creating products or solutions to cases or problems based on research and innovation.

The aim of this study is to present the possibility of integrating design thinking into the project-based approach in IT education in the profiled web design training, by drawing a parallel between the characteristics of the two approaches, where the meaning and the need of integrating the two approaches are explained. The advantages of combining the two

approaches for students are described in detail. A theoretical model is presented that can be applied in web design classes and through which students increase their motivation and engagement with the subject matter, develop skills such as creativity, critical thinking, innovation, responsibility, organizational and communication skills. This is a prerequisite for a more effective learning process, ensuring a deeper learning of the learning material, where the role of the teacher as a mentor and the activity of the students are key factors for its realization.

1. Design Thinking – Definition and Historical Development

The greatest contribution to the development of design thinking is attributed to the design and consulting firm IDEO, with its CEO Tim Brown providing the most widely used definition, "Design thinking is a human-centered, innovation-driven approach that draws on the designer's toolkit to integrate the needs of people, the capabilities of technology, and the requirements for business success" [1].

As an idea, design thinking originated much longer ago, as early as 1960. In Fig. 1, the key stages of development are presented in the form of a timeline, from the 1960s to 2004 [2].

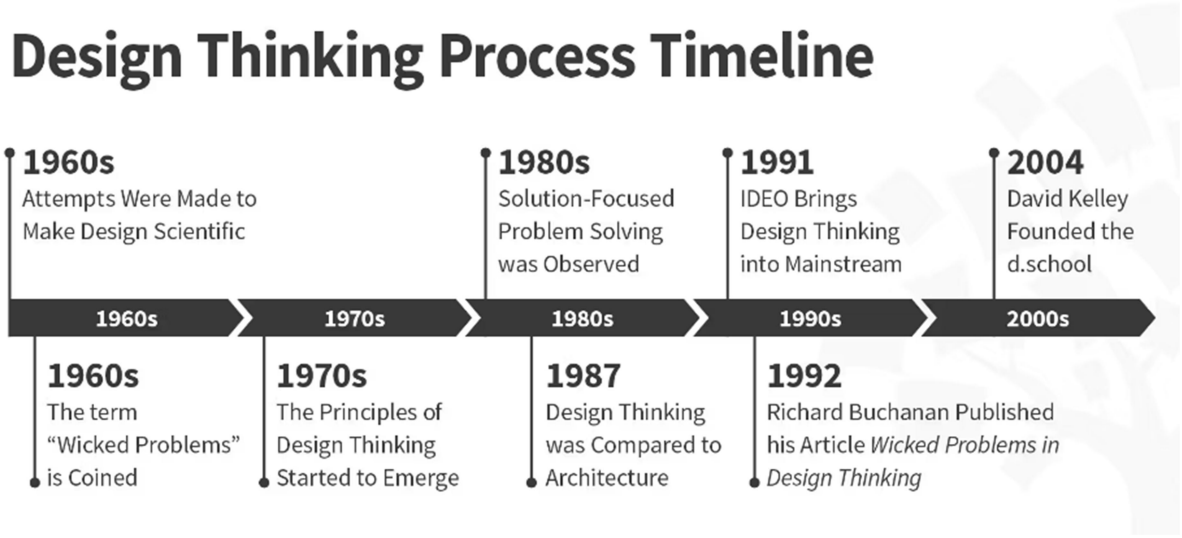

Fig. 1. Timeline of the development process of design thinking.

1960s

In the 1960s people began to explain design scientifically, applying different methods, approaches and processes in an attempt to understand how it works and what influences it. In 2001, in his article "Designerly ways of knowing: design discipline versus design science", Nigel Cross wrote at length about Richard Fuller's struggle to establish design as a science [2]. As Cross puts it, Fuller "called for a "design-science revolution" based on science, technology and rationalism to overcome the human and environmental problems that he believed could not be solved by politics and economics" and after a decade he succeeded in making it scientifically sound [2].

According to Dam and Teo (2022) [2], the term "wicked problems" was coined by Horst Rittel, a renowned design theorist who worked in the field of design problems and their solution. This term refers to social or societal problems that are difficult to define because of the confusing and contradictory information they contain. There is no clear-cut definition for these problems and the accompanying solutions cannot be defined as right or wrong, and the outcome may lead to unintended or undesirable consequences. Szczepanska (2017) [3] writes

that the term was coined by Horst Rittel and his colleague Melvin Webber in 1972, and Rittel was one of the first researchers to attempt to define design theory, focusing on design methods and paying attention to human experience and perception. Skaburskis (2008) [4] explores the origins of this concept in more depth in his article "The origins of wicked problems". In it, he points out that in 1967, during a seminar at the University of California, Rittel spoke about the differences between social and scientific or technical problems, at the end of which West Churchman credits Horst Rittel with introducing this concept. Later in 1973, Horst Rittel together with Melvin Weber published the concept of "wicked problems" [4].

In 1969, Herbert Simon published "The sciences of the artificial", where he "outlined one of the first formal models of the design thinking process", providing a new set of classifications and parameters [5], [3].

1970s

In the 1970s, the principles of design thinking began to take shape, and in the 1973 Robert McKim published his book "Experiences in visual thinking". He focuses on the impact that visual thinking has on our ability to understand and solve problems [2]. In his book, McKim explores different aspects of visual thinking and design approaches that are used in problem solving, while focusing on the interaction between the two brain hemispheres as a key factor for a holistic approach to cognition and innovation [2]. His methods and approaches are at the core of process design thinking.

In 1971, Victor Papanek published his book "Design for the real world", in which he examined design in terms of social responsibility and environmental impact. In it, he explores how design should benefit the user and how it plays a key role in all stages of the product life cycle – production, consumption and waste management [6]. Environmental impact refers to the creation of physical products with care for the environment, which includes the use of environmentally friendly raw materials and materials, waste minimisation and energy efficiency. The term "eco-friendly" is not used in the context of web and software design, but encompasses the material aspect of design where actual physical products are created and where design thinking as a method actually originates.

In 1979, Brian Lawson published an article describing an experiment conducted with scientists and architects in their attempt to solve the same three-dimensional problem. In it, he described the different approaches they used, concluding that the architects' focus was on solving problems, while the scientists focused on the problems themselves [2].

1980s

Nigel Cross in 1982 wrote the article "Design ways of knowing", considered foundational in design, in which he discusses the nature of problem solving processes and draws a parallel with solutions other than design but applied to everyday problems [2].

In 1983, Donald Schön published his book "The reflective practitioner: how professionals think in action". In it, he presents his concept of reflection in action, in which he stresses the importance and necessity of learning from experience and continuously analysing and reflecting on one's own actions and decisions during the design process [7].

Peter Rowe published his book "Design thinking" in 1987, in which he explored the way in which design architects approach their projects from a perspective of curiosity. He found that "curiosity" and "inquiry" were of the utmost importance because they were key factors in the process of creating buildings and urban artefacts.

Donald Schön, Brian Lawson and Peter Rowe give design an interdisciplinary character, coming to the idea that regardless of perspective and field of application, it can be seen as a

"universal approach to analyzing and transforming the surrounding reality" [8]. Lawson and Rowe use the term "design thinking" in their writings of the late 1980s and early 1990s, while Schön uses the term "reflection in action", yet all three argue for the way of perceiving the surrounding world while working to implement the process to obtain the required outcome.

1990s

In 1991 the company IDEO was formed to promote design thinking and develop its own terminology and methodology for it. Its philosophy is that design solutions should be human-centered while creating valuable products and services. Tim Brown, Bill Mogridge, David Kelly, Tom Kelly and Jane Fulton Suri have made outstanding contributions to the field of design, each an expert in his field and author of a number of books.

Richard Buchanan renewed the discussion around "wicked problems" by publishing "Wicked problems in design thinking" in 1992. In it he posits the concept of the relationship between design thinking and innovation, and how this can be put into practice. Buchanan discusses the development of the sciences over time and their separation as separate disciplines, and design thinking is the possibility of linking them together through its integrative nature [3].

2000s

David Kelly founded the Hasso Plattner Institute of Design in 2004, which focuses on fostering and developing each student's creativity and innovative thinking. The use of a human-centred approach to the design process, together with the application of different techniques and approaches to design thinking, underpin their work on real case studies and projects through which they create value in the products or services they develop. The rapid development of internet and mobile technologies is a prerequisite for design thinking to be adapted from the creation of real physical products to the creation of digital products. The principles of design thinking popularised by IDEO, such as empathy, idea generation, prototyping and testing, are increasingly beginning to find application in software development and web design. Design thinking plays a key role and is an essential part of UX design, which is user-centered and its main function is to pique the interest of users, stimulating their engagement.

Since then, design, and design thinking in particular, has evolved continuously and at a rapid pace, driven by the rapid development of technology and the different and changing worldview of users.

2. PATTERNS OF DESIGN THINKING

The process of design thinking is explained or represented in the form of models in different ways depending on the number of stages or phases that accompany it. Despite the differences in the terminology used and the steps proposed in the representation of this process, the models are based on the basic concept of the human-centred approach, which places the human at the centre of all design processes and decisions, dictated by user preferences and needs. Common features include:

- Empathy

Any intention to create a product or service is based on the needs and wants of users. Through empathy, designers try to imagine what users are experiencing and thus understand what they would feel if put in their shoes.

- Cyclicality

To select the most effective solution, the design thinking process needs to be not linear but cyclical in nature, for which purpose it needs to be composed of the required number of iterations of stages. This is a prerequisite for product or service improvement.

- Creativity

Creativity is a key factor in the implementation of each stage and aims to stimulate thinking by generating ideas outside the framework of predictable solutions. No idea or thought should be dismissed out of a preconceived notion of possible failure; on the contrary, every idea needs to be given due consideration in the search for unconventionality and originality.

- Criticality

It is a prerequisite for the creation of products with aesthetic and functional design that each solution is approached critically, where all ideas, concepts and technologies are analysed in detail in order to implement solutions that combine efficiency, innovation and ethics.

- Prototyping and testing

Prototypes are models or mock-ups based on the ideas selected after analysis and give a clear idea of what the future product or service will look like. It is essential to create prototypes and test them in order to correct any errors or make improvements.

- Collaboration

Design thinking connects the work of many specialists and experts with different skills from a variety of fields and areas who manage to unite their efforts around common ideas and solutions.

The main and most widely used models of design thinking are discussed next.

The Double Diamond model was developed by the US Design Council in 2003 and depicts design thinking by illustrating the process of design and innovation (Fig. 2). It represents the steps that each design and innovation project goes through regardless of the methods and tools used [9].

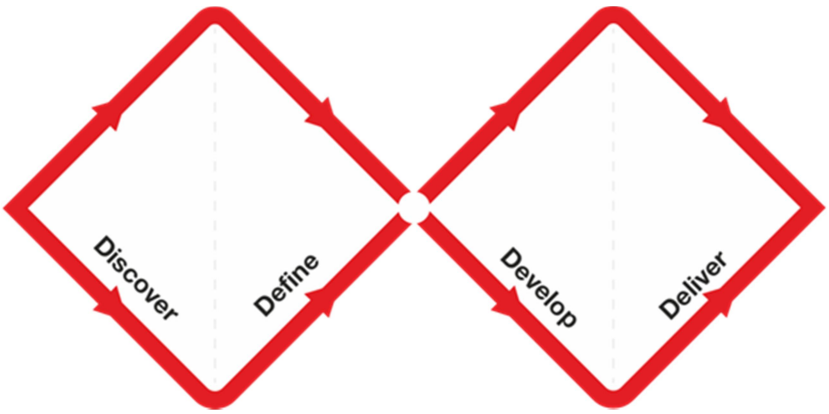

Fig. 2. Double Diamond model.

The first diamond helps to look into the problem and become aware of it rather than just guessing what it is. The "discover" stage involves meeting and talking with the people who are affected by the issues in question. In the "define" stage, the challenge is defined in a different way, and therefore the findings and conclusions reached beforehand help.

The second diamond stimulates the proposal of diverse solutions to the specific problem. In the "develop" stage, the aim is to come up with different ideas and answers from the obvious ones, seeking new possibilities and inspiration from all that is around us. Teamwork and bringing together people with different backgrounds is a prerequisite for innovation in the development stage. The "deliver" stage consists of testing different solutions

on a smaller scale, discarding those that are unworkable or inappropriate and making improvements where needed.

In 2008, Tim Brown presented it broadly in three stages, which represent overlapping circles: the largest – inspiration; the second – ideation; and the third, smallest – implementation [10]. Inspiration is the motive that underlies the search for solutions to problems in different domains – what are the difficulties encountered; what are the constraints facing them and what can be improved. Ideation is a process where ideas are created, developed and tested through various techniques. The third round is implementation, in which the project is carried out. Finding the best idea and implementing it requires going through these stages more than once, with each stage interacting with the other.

IDEO Design Thinking [9] depicts the three main stages of the design thinking process as a cyclical process, where each stage interacts with the others and requires at least iterating through them to refine the idea and select the best solution (Fig. 3).

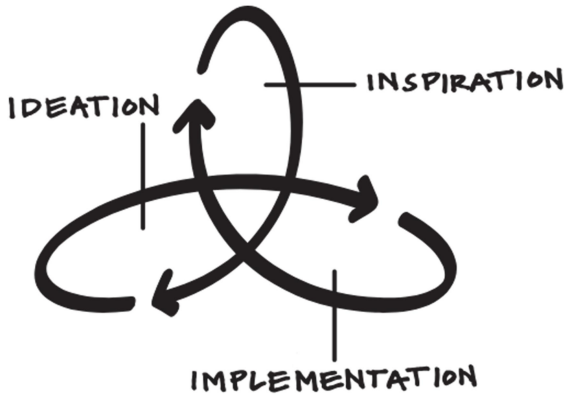

Fig. 3. The design thinking process according to IDEO.

The most common model of design thinking is that of Hasso Plattner Institute of Design at Stanford, which includes five phases – empathize, define, ideate, prototype and test (Fig. 4) [11].

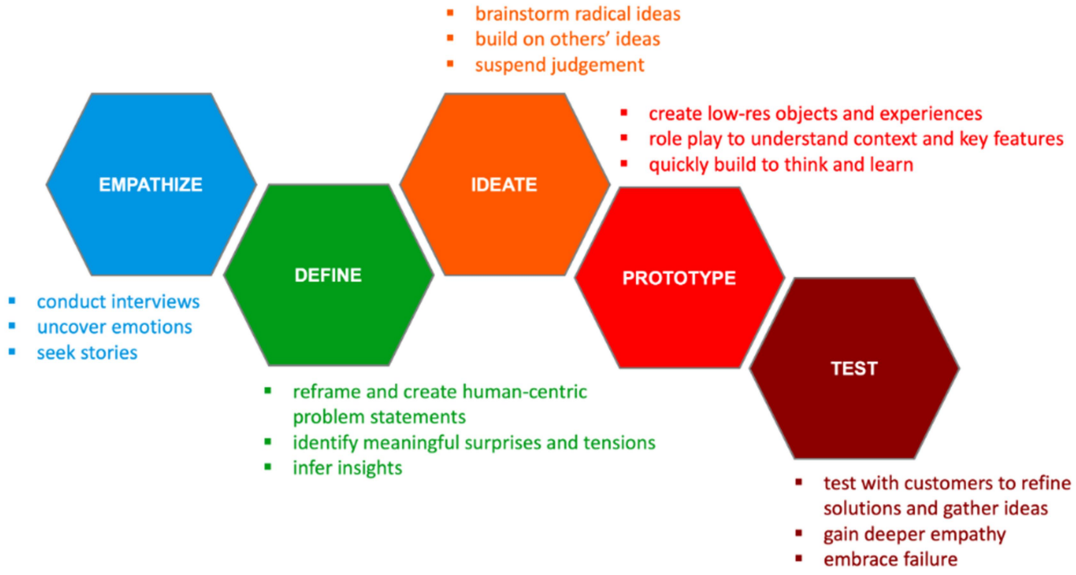

Fig. 4. Stanford University model of design thinking.

- Empathize

At the core of design thinking is empathy, the goal of which is to understand people, why they perform an action, what motivates them, what they care about, what their physical and emotional needs are relative to a particular design challenge. In order to be able to gain insight into the feelings, thoughts and desires of others different techniques need to be used such as observation, engaging through interviewing or conversation, watching and listening.

- Define

This phase brings clarity and focus by reframing the problem from the person's perspective, identifying unexpected twists and turns and built-up tensions. Insights in most cases do not emerge immediately, but are the result of a "process of synthesizing information in which connections and patterns are uncovered" [11].

- Ideate

The essence of this stage is the generation of ideas, unleashing the potential of thinking activity in terms of concepts and feasible solutions. Through the resulting inspirations, new and unconventional solutions are generated, through which the prototypes are created after critical evaluation.

- Prototype

The prototypes aim to answer all questions related to the realisation of the product, such as whether it is efficient, whether it meets consumer expectations, whether it is developed according to environmental requirements, etc. Techniques are used to allow the user to interact with the product, such as a role-playing game, a device, etc., so that they can experience the emotion and sensations that will lead the process to its finalisation.

- Test

In this phase, the prototypes created are tested by the users and the feedback from the surveys is summarised. The results of the user experiences are intended to provide a more detailed picture of user reactions, whether people's expectations have been met, what has been achieved and what can be improved.

Stanford University's design thinking model is most relevant and widely used in web design. Depending on how users perceive information and what their need for interactive and diverse content is, different websites, digital platforms and applications are created [12]. In the context of education, the integration of digital technologies makes learning faster, broadens its scope, makes it more accessible and more demanding [12].

3. Project-based Approach – Nature and Characteristics

Project work is at the core of the so-called project-based learning approach, where students develop in-depth knowledge and skills through projects that stimulate them to develop their logical and critical thinking, increase their engagement and motivation, and improve their communication skills [13].

Nikolaeva (2007) [14] points out that, according to historical records, projects were first used as a method of education more than 400 years ago (1593) at the "St. Luke" in Rome. About 30-40 years later, the projects method was widely applied in training in architectural academies in Italy and France, and by the early 18th century it was widely used in technical and business schools in the Netherlands, Finland, England and Russia [14]. In 1897, John Dewey published his understanding of the concept of "learning by doing" in "My pedagogic creed" in which he focused on the experience and experiment in teaching using this approach. He is credited as one of the founders of project-based learning along with William Kilpatrick, who developed his idea further. Kilpatrick's publication of "The Project Method" in 1918 led to wider publicity for Dewey's philosophy of project work used as a method in training. The two created a new approach that was different from the traditional one and that focused on the

active role of students, with "learners constructing their own knowledge, analyzing the information they receive, constructing and proving hypotheses, and developing their critical thinking" [15, p. 17].

The project-based approach "provides an opportunity for learners to learn by "integrating" new knowledge into existing knowledge structures" [16, p. 45]. Project-based learning work provides an environment in which complex educational goals can be realised, addressing students' development both in their knowledge and in their emotional-social development. It enables to adapt to the "individual capabilities, needs and learning styles of students" [17].

The need for project-based learning is confirmed by the research done on the characteristics of meaningful learning. These underpin the theory of Renate Kane and Geoffrey Kane, who endorse 12 principles of natural learning focused on the ways in which the brain, mind and environment interact to create an effective learning process. The essence of this theory is that learning is a natural and continuous process in which meaning is made through the interaction of these three components [18].

The key characteristics of project-based learning include:

- Focus on real-world case studies and problems

In project-based work, students are presented with real cases or problems that are important to them or society. Because the learning is practice-oriented, the learners' interest is piqued and thus they realize the usefulness of what they are doing. The presence of a problem situation, where the students come to certain conclusions and a concrete solution, aims to activate their thought process and desire to learn, as well as further development according to their interests. Understanding the meaning of the project, as well as the advantage and opportunity to apply what they have learned outside the classroom, is a prerequisite for enhancing their intrinsic motivation.

In project-based learning in web design, students develop a website in teams, focusing on planning, designing and creating it. Students research competing websites, analyzing their strengths and weaknesses in terms of design, content, and functionality. In the process, students are presented with a variety of choices related to technology or platform selection, the overall look and layout of elements, the logical structure and navigation scheme of the site, color scheme and font selection.

- Interdisciplinarity

Applying an interdisciplinary approach to the learning process enables students to combine knowledge and skills from different fields, which aims to achieve a deeper understanding of the material studied and to solve complex problems. This allows for a detailed exploration of the given case study and its related topic through research, synthesizing and analyzing information. The use of cross-curricular connections provides opportunities to ask questions throughout the project, which increases student engagement. Through the interdisciplinary approach, learners develop their critical thinking, creativity and motivation.

- The active role of students

Unlike traditional learning, where students have a passive role, here they have an active participation in the learning process. Learners can plan and allocate their time to tasks, both independently and among themselves. They learn to set specific and general goals, but also to analyse the outcome, while taking responsibility for the decisions they have made. Learning in the project-based approach is dialogic and students can ask questions throughout each stage of the project, thus solving problems as they arise. Keeping records and tracking the correct completion of tasks develops their self-control and critical thinking.

- The teacher's role as mentor

The teacher in this approach has a different role, which is not only to impart knowledge to the students but also to act as a mentor. He assists and guides the students in their project work, striving to help them reach the necessary conclusions and decisions themselves, while encouraging their initiative. The teacher aims to encourage the students to be active in seeking information from different sources, to share their opinions and ideas without embarrassment, to listen to each other by being tolerant of the statements of everyone in the team. It aims not only to enhance students' interest but also to form lasting habits of learning, analytical and critical thinking, self-control and self-improvement.

In web design classes, the teacher shows different websites with good design and content, drawing attention to how important they are to the effectiveness of a website. He introduces them to the basic web technologies and languages for building the structure and visual layout of a web page, drawing attention to their advantages and disadvantages. In particular, he draws attention to the importance of respecting legal and ethical norms on the internet when publishing content on a website.

- Teamwork

In the project-based approach, most projects are carried out in teams where the work is distributed among the students and each of them has a role and responsibilities. Team members exchange opinions and ideas and thus learn from each other. Assigning tasks and making a plan during the project stimulates learners' activity and commitment. By working on a project, students develop their conflict resolution, tolerance and communication skills. Abilities for effective collaboration between team members, active listening and empathy are developed.

- Getting feedback

Throughout the project, students have the opportunity to observe the different stages of the process and consider the results that their decisions have led to. The step-by-step analysis of what they have learned and achieved motivates them to deepen their knowledge and skills. As a result of reflection, students strive to make changes where necessary and so make progress towards their goals. By receiving feedback, learners are stimulated to give themselves real self-evaluation and to improve.

In project-based web design training, each site needs to be tested to check its visualisation and functionality. In class, students learn to use website testing tools, web page validation tools, use of emulators, and tools to test the accessibility of a website.

- Creating a final product

The finalisation of the project is the creation of a final product, which can be different, e.g. a presentation, a website, a mock-up, etc. and which has to be presented to an audience, be it the class, other classes, parents or the public. The product of each project should be presented and its advantages and benefits should be pointed out through arguments, through which students develop their speaking and reasoning skills in front of an audience. Seeing a tangible result as a result of their work brings satisfaction, which encourages pupils to take responsibility in order to make progress.

In the context of learning web design, students gain knowledge of the need to evaluate and optimise a website, as well as the skills to use tools to analyse its traffic and tools to promote it.

In contemporary learning, the application of the person-centred approach to project-based learning is increasingly observed, with the aim of personalising projects to the individual differences and characteristics of students. Through the person-centred approach, the focus is on the individuality of students – their interests, needs and motivation. According to Petrov [19, p. 309], "the discovery and development of aptitudes is an important social task, since the progress of a society largely depends on how it realizes the potential capabilities of each of its members". Key aspects of the person-centred approach are

differentiated learning, the ambition for further self-improvement and the motivational environment.

The stages of preparation for a project in the project-based approach include:

- Project assignment, formulation of goals and objectives;
- Forming teams and defining the main activities for the project implementation;
- Project work – preparation of a time schedule of tasks, definition of the sequence of actions in the process of work;
- Project deliverables – testing and evaluation based on various indicators – accessibility, design, content, technological aspects and interactivity.

4. Integrating Design Thinking into a Project-based Approach to Teaching Web Design in Schools

The development of information technology and digital competence is a prerequisite for the combination of modern and innovative teaching methods in IT classes and in particular in those where web design is taught. The teaching methods used are verbal, visual and practical, which, according to D. Lordkipanidze, E. Golant, N. Sorokin, and others can be represented by the following classification based on the source of knowledge (information) [19]:

- Verbal – narration, explanation, lecture, work with textbook and book;
- Visual – observation, demonstration, audiovisual perception;
- Practical – exercises, laboratory work, practical classes.

According to V. Palamarchuk, there are 23 different factors that teachers should take into account when choosing a teaching method, but the most characteristic ones are [20]:

- The specifics of the subject and the learning material;
- The content of the material;
- The nature of the connections between the elements of the learning material;
- The goals and objectives of the specific lesson;
- The abilities of the students;
- The teacher's mastery;
- The textbooks and teaching aids.

The best graphic representation of the relationship between the method of presenting learning content and the degree of its assimilation is the so-called "Cone of experience" concept by Edgar Dale (Fig. 5) [21].

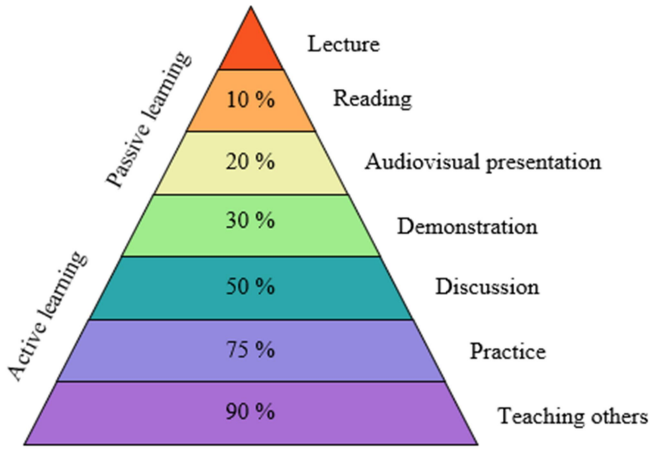

Fig. 5. Cone of experience.

The percentages were added following empirical studies in education conducted by other authors who shared Dale's idea. They represent the extent to which information is learned and retained through each respective method. The figure shows that when moving from passive to active learning, the percentage of material retention increases. The combination of verbal and visual methods of presenting information is based on the ability to transform information through the capacity for modeling. Each individual, depending on their intellectual abilities, "demonstrates a specific orientation toward verbal-visual, symbolic, or other models as expressive means of sensory, figurative-logical, or abstract thinking and cognition" [22].

Tuparova and Georgieva (2020) [23] present a model that parallels the different stages and appropriate teaching methods and can be applied by the teacher in the classroom when using design thinking in teaching (Fig. 6).

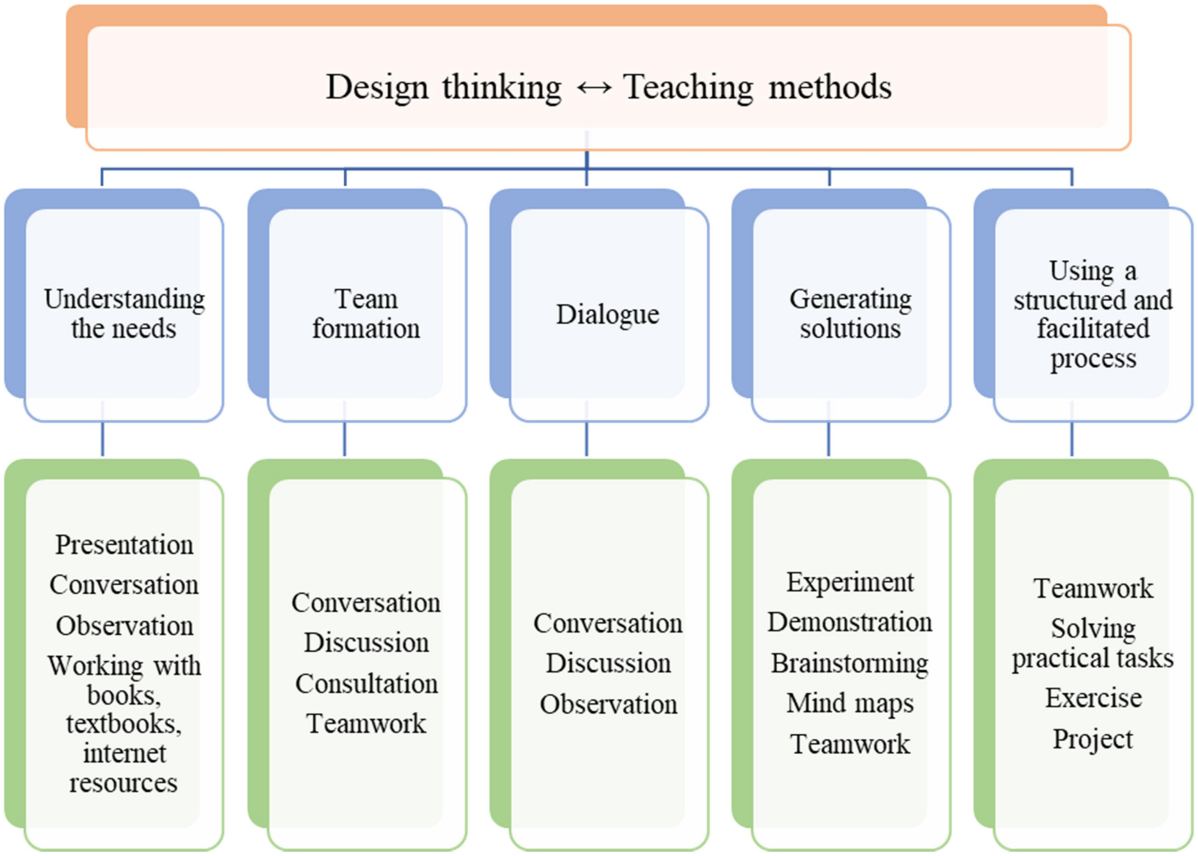

Fig. 6. Teaching methods in the stages of design thinking.

Integrating design thinking into a project-based approach to teaching web design in school aims to combine creativity and innovative thinking with students' practical skills. Combining the human-centred, innovation-focused approach of design thinking with the exploratory and interdisciplinary approach of project-based learning creates a different atmosphere in the classroom, especially in IT classes where web design is taught. The rapid development of web technologies poses challenges for teachers in updating their curricula, approaches and teaching methods, and combining these two approaches ensures that students' interest and intrinsic motivation are piqued.

4.1. Comparative Characteristics of Design Thinking and the Project-based Approach

The rationale and need for combining the two approaches in web design education can be argued by the following parallel between the characteristics of the two approaches:

- The human-centered approach and the active role of the student

In both design thinking and the project-based approach, the focus is on the student and learning by doing. Students are not passive in the learning process, but actively participate in the acquisition of knowledge, taking an active part in both approaches. While in the project-based approach concrete products are created as a result of certain decisions, in design thinking the question of how to create and why to create a product is answered. The process of creation is deepened by focusing on the empathy, wants and needs of the users and thus the realised product is created by taking into account every single feature, detail and characteristic of it. In the context of learning web design, students create projects that are of interest both to themselves and to society – websites, blogs, etc. The opportunity to choose the topic on which their project will be, increases their motivation and commitment at every stage. The confidence that they are working on something that is important to them, meaningful and has a real application, develops their learning skills, initiative and responsibility. In web design classes, students can apply their HTML and CSS knowledge in a real-world situation, test different solutions and use different tools to create websites, such as WordPress, GoogleSites, etc.

- Collaboration and teamwork

In design thinking, collaboration is focused on solving problems related to user needs, for the purpose of which the knowledge of people from different fields is combined. In the project-based approach, its focus is on solving a specific problem, and in both cases teamwork accompanies the different stages in the project. In web design education, the use of both approaches combines students' organizational and communication skills with their interdisciplinary teamwork skills. In these classes, students learn to take on responsibilities, express themselves, share ideas, and express opinions by justifying themselves with arguments.

- Staged process development and cyclicality

The process in design thinking, as in the project-based approach, goes through stages of research, analyzing the information gathered, creating, testing, and refining. Through the iterative nature of both approaches, students develop the skills to accept and analyze their mistakes, which motivates them to learn and continuously develop. In the context of learning web design, they can learn from their mistakes, such as buttons or links that don't work, lack of good site navigation structure, poor readability, poor choice of colour scheme and poor user interface.

- Creativity and innovation

Both approaches focus on creativity and avoiding trivial choices and solutions. Design thinking encourages the generation of out-of-the-box ideas, even those that at first glance seem unfeasible. In project-based learning, innovation is sought, but also inventiveness. Combining the two approaches allows the individuality of each student to come out. Through it, in web design classes, students can show creativity in the choice of color scheme, the selection of fonts, the creation of logos and favicons, the overall look and placement of elements, the tools and technologies used.

- Reflection and evaluation

Analysis at each stage in both approaches is a key factor in realizing a product. In project work, this is done by examining in detail the documentation kept, the activities and actions implemented in the process of work, the presentation of the final result. In design

thinking, emphasis is placed on the opinions of users who actually test and evaluate the product, the outcome of which helps to correct errors and make improvements. Applying both approaches to learning web design develops students' discipline and critical thinking skills, and in the process they discover their own mistakes as well as those of other team members, and can analyze and correct them – whether the right amount of time has been allocated to complete tasks, whether the right team roles have been selected, and whether necessary actions have been taken. Learners are able to make a realistic assessment of whether they have used the necessary tools and technologies. After analyzing, learners can make necessary adjustments to the site – make changes to the content, include more or less interactive elements, strengthen responsive design, and improve the overall user experience.

The integration of design thinking into project-based learning as part of the learning process can be applied in web design classes in the profiled course where Module 3 Web Design is taught. The in-depth consideration of the process of creating a website and the sufficient number of hours in the second secondary school stage in the 12th grade in the subject of information technology are sufficient conditions for this to be put into practice.

The effectiveness of design thinking instruction is increasingly gaining popularity as it assists teachers across subjects in addressing more complex challenges in their practice [24]. However, very few are trained in design thinking, and this provides the rationale for Calavia et al. (2023) [24] to present a Think-Create-Teach methodology to help preservice teachers create instructional materials guided by design thinking. In support of their methodology, Calavia et al. (2023) [24] identify some key differences between a project-based approach and design thinking that can have a significant impact on the preparation of preservice teachers (Fig. 7).

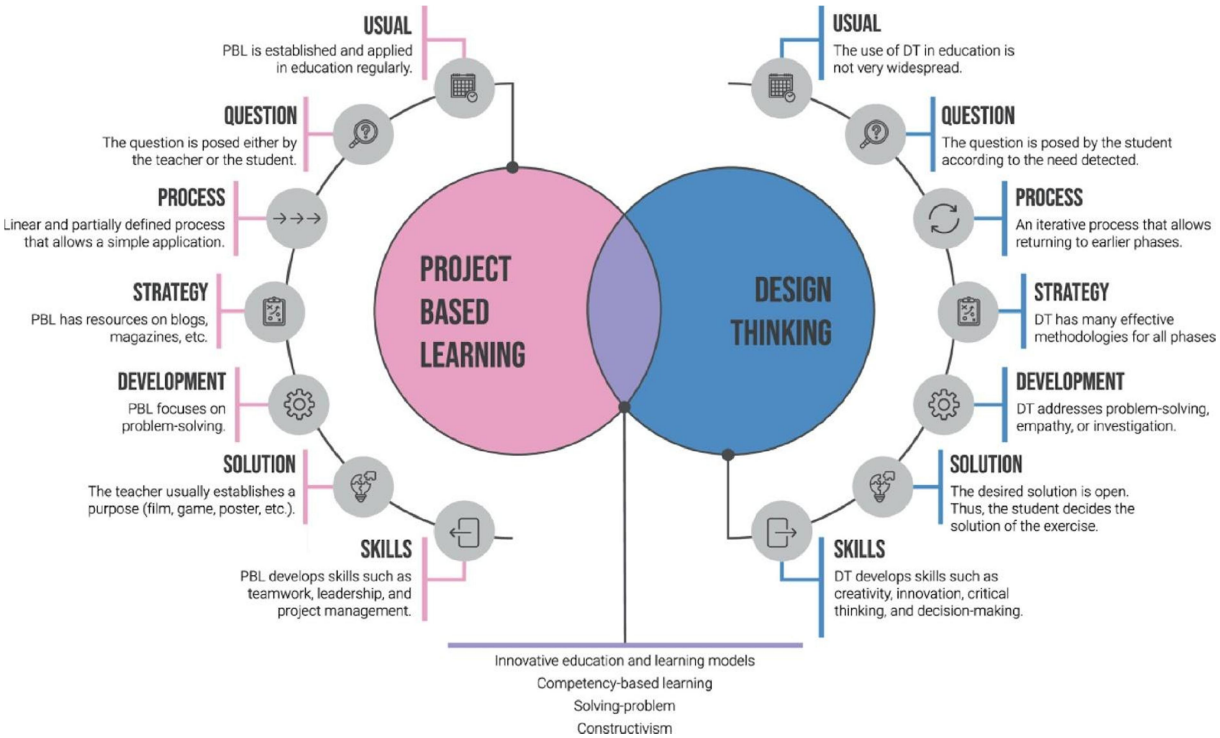

Fig. 7. Characteristics, differences and similarities between project-based learning and design thinking.

Fig. 7 shows the differences in the two domains, grouped by category:

- Application: project-based learning is a well-established and applicable method in education, unlike design thinking, which is not yet as widespread;

- Question Formation: In project-based learning, the question is asked by the teacher or the student, whereas in design thinking, it comes from an identified need;
- Process: In project-based learning, the process is linear and partially defined, whereas in design thinking it is iterative with the possibility of returning to previous stages;
- Strategy: project-based learning is based on resources such as blogs and journals, while design thinking offers methodologies for each of the stages;
- Development: Project-based learning focuses primarily on problem solving, while design thinking also adds empathy and exploration;
- Solution: In project-based learning, the teacher usually sets a goal that predetermines the solution from the teacher, such as a movie, game, poster, etc. In design thinking, the decision is open and up to the student.
- Skills: Project-based learning primarily develops skills such as teamwork, leadership, and project management, while design thinking fosters creativity, innovation, critical thinking, and decision making.

What both models have in common is that they are innovative educational and training models based on a competency-based approach, problem solving and constructivism. On the one hand, the competency approach focuses on the formation of knowledge, skills and attitudes in the learning process that students can put into practice, and on the other hand, through constructivism, learners actively participate in this process using their accumulated knowledge and previous experience.

4.2. Presenting the Process of Creating a Website through Design Thinking and a Project-Based Approach

The stages of creating a website using the two approaches can be represented by the following example model (Fig. 8):

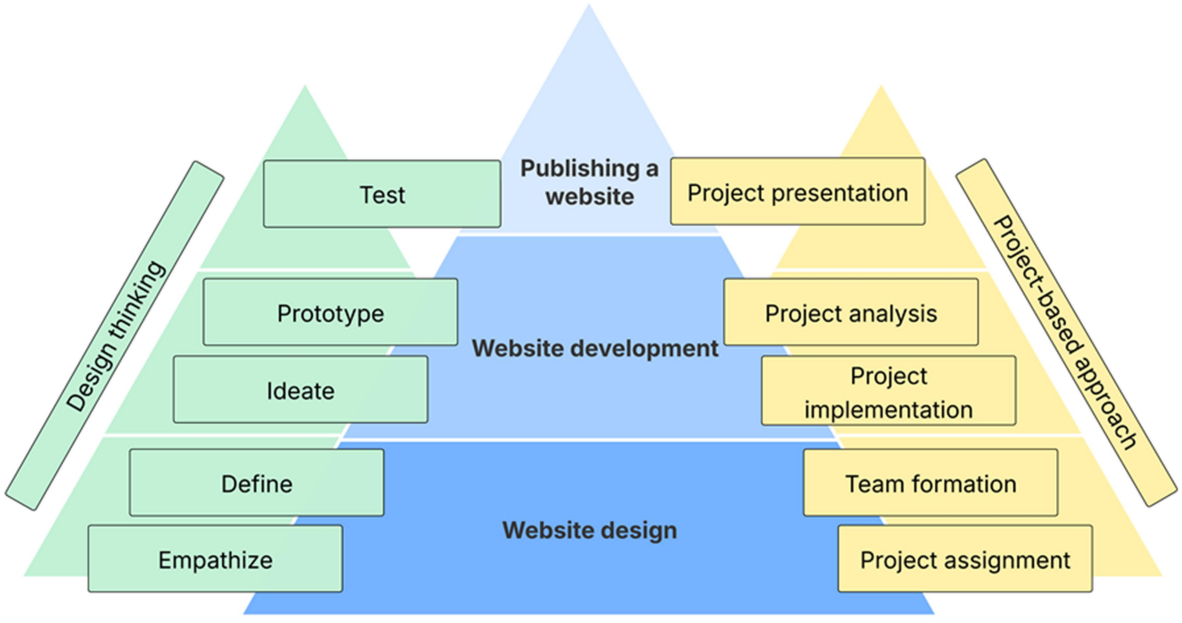

Fig. 8. Representation of the process of creating a website through design thinking and project-based approach

It presents the three stages in the process of creating a website with the corresponding ones from the design thinking and project-based approaches. A pyramidal structure is chosen for its visualization, the idea being that in the first stage the activities are the most numerous and diverse in nature, and subsequently the ideas and possible solutions are clarified, leading to the finalization of the process, the ultimate goal of which is to finally have a realized product or service.

- Design

This stage of web development brings together the empathy and problem definition of design thinking with the project brief and team formation of a project-based approach. To this end, two sub-stages can be formed to combine the two approaches:

- Developing empathy in order to form the project brief

In order to be able to choose the right topic for their site that corresponds with its focus, students need to explore people's real needs and problems by developing empathy.

In the context of web design education, this can be done by conducting observations among students – in different age groups – about what their interests and hobbies are. The teacher helps with guidance on what and how to observe and with tabulating the results.

Those who have aroused the interest of the observers can be asked questions using the technique of "interviewing", the aim being to make this more of a conversation where the interviewee does not have the embarrassment of sharing their thoughts and feelings. The questions can also be clarifying and guiding so that a specific conclusion can be reached. The teacher gives examples and guidance to students on how to put this into practice, and may show them a sample of questions in tabular form with space for answers. He can initiate a meeting of the learners with successful personalities who have developed in their field and to whom they can ask questions related to real life.

Students can prepare a questionnaire to be completed by their parents and those who have sparked interest can be invited by the teacher for discussion at school.

With the help of the surveys done through empathy, the students are able to form the project brief against the project-based approach, which is the starting point for the website.

- Defining the problem and forming teams

The students have to systematize and analyze the findings, considering them from all perspectives and arriving at a clear description of the problem to be solved. This provides the basis on which the website will be built. In order to arrive at a correct formulation, the teacher introduces the learners to different techniques that can be applied in the learning process.

Through the technique of "Problem Description", students ask questions such as "How can ... be improved?", "How can ... be helped?", "How can ... be implemented?" etc.

With the help of the "5 whys" technique, the reasons to be identified are found. It asks the question "Why is that?" five times for each subsequent answer, with the real problem found in the last answer. In cases where the cause is perceived as technical in nature, this technique often reveals that human error is at the root of the problem [25]. Therefore, the use of this technique has a real application in website creation.

The students have a discussion in which they discuss what the needs of the consumers are that the website will target.

Defining the problem determines how the roles in the team will be allocated according to the individual capabilities of each of the participants. For proper assignment of responsibilities, the teacher may suggest a method to be used to accomplish this. The best way to define and assign roles in project work is by using a responsibility matrix, the RACI matrix [25]. The abbreviation RACI stands for: R – responsible (does the main work of the assignment), A – accountable (who gives final approval), C – consulted (must be agreed and coordinated with) and I – informed (must be kept informed of progress). The matrix is a table where the column headings are the names of the people in the team and the row headings are

the activities to be completed. In the cells that overlap the rows and columns, the letter corresponding to the expected responsibility is inserted.

- Develop

The website development stage involves the idea generation and prototyping from design thinking and the implementation and creation of the project from the project-based approach.

In design thinking, the aim is for students to say and share all their ideas, even those that are potentially unfeasible and without worrying about criticism from others. Compared to the project-based approach, in the implementation stage the ideas through which the site would meet the expectations and needs of the users are implemented.

Idea generation accompanies the project implementation stage. The teacher introduces students to various techniques through which the mind seeks to go beyond traditional thinking and which facilitate the coming up of out-of-the-box ideas. He also determines the duration in minutes of the technique he has chosen.

There are different types of idea generation techniques, but for the purpose of the training, the ones that would help students achieve better results have been selected. According to Dam (2025) [26], it is important which techniques will be chosen at the beginning of the stage to stimulate free thinking and which ones towards the end of the stage to help select the best ideas to take the process forward.

"Brainstorming" is the most widely used creative thinking technique and is characterised by the spontaneous expression of ideas or solutions, and can be applied both individually and in groups. Students express their ideas freely without being subjected to criticism or evaluation. In the context of learning web design, they can propose different ideas related to the content of the site, its structure, navigation, design and user experience.

Through "brainwriting", students record their ideas on slips of paper, then pass them on to the next student, who develops what they have written. In this way, each learner can suggest a change to the homepage of the site, adding or removing sections, more or less interactive elements, changing the color scheme, font, etc. This technique allows the more apprehensive learners to express themselves, removing the possibility of them being apostrophised and criticised [27].

"Worst possible idea" is a technique through which students look for the negative and worst aspects and solutions to a problem. This reversal in thinking takes the pressure off the learners because there are situations of laughter, it boosts their confidence by stimulating creativity and often results in them getting successful ideas [28]. In a website design project, this method finds application in rethinking ideas and innovation, increasing user experience and reducing user frustration.

The use of the SCAMPER technique is one of the most widely used in the field of UX design because in this technique, idea generation is the result of obtaining different perspectives from seven categories: S – Replace, C – Combine, A – Adapt, M – Modify, P – Put to another use, and R – Rearrange. Students ask questions under each of the categories, the answers to which give them a broader view of what to include on the site and how to adapt it to different specifics.

Through the stages of prototyping and project analysis, design thinking and a project-based approach respectively, feedback is obtained to improve the structure, design and functionality of the website. This helps to arrive at the realization of a better website against the preliminary requirements and guidelines. The teacher visually shows how students can prototype their website and assesses which of the methods is better for the purpose.

Using the "paper prototype", students present sketches where they have drawn by hand what the pages of the website will look like – how it will be laid out, what the menu will be,

what buttons it will have and what its content will be. It gives clarity on what the user interface will be and what navigation the site will have.

The "wireframe" is used to present the structure of the website without specifying colors and images. In this way, the layout and functionality of the site is made clear. Students can represent it, for example, by using specialist software such as Figma, PowerPoint and Photoshop.

Creating a layout that visually shows without interactive elements what the content of the site will be, what its colours will be, what fonts and images have been selected, gives a realistic idea of what the site will look like. Tools such as Canva, Photoshop and Figma can be used for this purpose.

The more in-depth study of the subject matter in the profiled training enables students to use HTML and CSS to create a prototype with simpler functionality where they put their knowledge and skills into practice.

Through the feedback received and the analyses of the project so far, they proceed to the final stage of the website creation process.

- Publication

Publishing the website as the final stage in the development of the website brings together the final two stages of design thinking and the project-based approach, testing and presenting the project respectively.

In testing, the prototypes are given to different people to test, for example students from other teams or classes, parents, teachers or experts from different fields. The students summarise the feedback received from the users and thus the process is finalised and a final product is created. In project-based learning, the website is presented to an audience – students from the class or other classes, parents, or an interested audience such as representatives from various companies. Based on predefined criteria, the website is evaluated.

Upon completion of the project, the teacher helps the students analyze the process of creating a website – what they learned, what skills they acquired, what they would change and do differently.

Combining design thinking and a project-based approach should also be applied as part of web design education in higher education institutions. This is already a necessity that is conditioned by the development of the economy, unthinkable without the use of web technologies. As Kotler (2003) [29] says "the digital revolution has fundamentally changed contemporary concepts of space, time and volume". For a long time, a company does not need a large space, even a virtual one can manage to reach everywhere and thus be successful [29]. The main goal in creating a final product in web design is to pique the interest of users, stimulating their engagement. Through design thinking and project-based approach, students understand the psychology of users and thus create better products and services. User experience encompasses all aspects of an end user's interaction with a system, including interface, graphics, industrial design, mental interaction, and more [30]. In web design education, the knowledge related to user experience should be deepened, without which it is already unthinkable to implement a project. As Bob Weiland says, "The philosophy has changed. Products come and go. What matters today is the relationship with the customer" [29].

In this regard and in relation to the dynamic development of the IT industry and the increasing presence of technology in modern everyday life, the need to study web design in various disciplines in higher education institutions has been determined. Each specialty has its own specificity and differs in the objectives set, the content of the study material, the approaches used and the teaching methods. This determines what subjects will be studied related to web design, whether they will be compulsory or elective and what their horary will

be. At its core, learning activities should be designed to stimulate students to learn, while the learning strategy is focused on retaining their attention, satisfaction, teamwork and practical learning [31].

Higher education is increasingly adopting the interdisciplinary approach, which combines different disciplines by integrating knowledge, methods and skills from different fields in the form of various innovative educational projects. In this case, in contrast to traditional education, students not only acquire knowledge but also learn to apply it in practice by solving different problems, looking at them from different perspectives of scientific fields. In this way, on the one hand, students are encouraged to grow in their professional path according to their interests, goals and ambitions, and on the other hand, the academic development of the professors from the different departments is stimulated.

The choice of appropriate teaching methods determines the effectiveness of the learning process, seeking to influence the knowledge, skills, habits, intellect, emotions, will and imagination of students in a holistic way. The most important goal is to stimulate and activate learning in order to achieve high results in the chosen field of professional study. In the context of design thinking and in line with changes that require updating learning in different aspects, changes could be made in the curricula, such as adding new topics related to:

- The deeper study of UX/UI design, with more emphasis on how gestalt psychology and human-centred design influence user experience;
- Accessible design – making web interfaces disability-friendly;
- Mobile friendly design – due to the increasing use of smartphones in everyday life, web design requires this type of design, whereby content is created for mobile devices and then adapted for larger screens.
- Design thinking – how to put it into practice by addressing its elements – empathy, definition, idea generation, prototyping and testing.
- AI in web design – pros and cons of using it in web design and how AI can be used in a project to improve the product.

The demand on the labour market for specialists in this field is a prerequisite for the introduction of new specialisations and the updating of curricula, approaches and training methods. Web design provides opportunities for the development of technical, communication and creative skills in students, and places emphasis on the ability for critical thinking and problem solving.

CONCLUSION

Design thinking and the project-based approach are current learning approaches that meet the challenges of dynamically developing information technologies, modern education and the needs of society as a whole. They focus on the active role of the student in the learning process, through which learners acquire skills for learning, initiative, responsibility, critical thinking, teamwork and solving real cases and problems. Combining the two approaches in web design classes creates a different learning environment, a creative atmosphere, which has a strong impact on students' motivation to learn, engagement and self-improvement. The learning process combines a human-centred, exploratory and interdisciplinary approach, resulting in the merging of creative and innovative thinking with the learners' practical abilities. The teacher has a key role, acting as a mentor who not only teaches the material but also supports, guides and encourages students in the learning process. His aim is to arouse the interest of each learner by encouraging his/her initiative not only in the various activities but also in sharing ideas and expressing opinions.

This study discusses the theoretical foundations of design thinking and the design-based approach. Based on this, an exemplary model of how the two approaches can be applied,

complementing each other, in the Web Design class in the profiled preparation, Module 3 "Web Design", is presented. It is planned to develop and introduce it in a web design class in the future, where students will be divided into two groups – an experimental group, where design thinking is integrated into the project-based learning approach, and a control group, where learning is carried out using the traditional method. Based on the results obtained from the two groups, relevant analyses and conclusions will be drawn.

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