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DESIGN THINKING: AN OVERVIEW OF NEEDFINDING IN EDUCATION

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Nowadays, modern education is incredibly diverse. Each university or school uses different successful approaches, such as peer learning, flipped teaching, building Fab Labs, Makerspases and opening University-Based Incubators. Despite the many approaches, mindsets, techniques and tools available in education, there is not a universal formula for what should be included in the educational infrastructure, or which tools are the most effective. These questions are ”wicked”, complex and unclear. The design thinking approach can help us transition from knowledge space to the concept space to effectively utilizing it. This paper provides an overview of several popular approaches and tools that have proven effective in higher education. Furthermore, this paper aims to inspire future research, utilizing the design thinking tool known as ”desktop research.” Through review and reflection, we aim to understand the effectiveness of the needfinding approach and its potential to uphold the integrity of the university and fulfill its initial mission.

Keywords: design thinking, education, management, innovation, needfinding in education

ДИЗАЙН-ОЙЛАУ: БІЛІМ САЛАСЫНДАҒЫ ҚАЖЕТТІЛІКТЕРГЕ ШОЛУ

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Қазіргі білім беру жүйесі керемет әртүрлілігімен ерекшеленеді. Университеттер бірқатар инновациялық тәсілдерді қолданады, мысалы, бірлесіп оқу, «төңкерілген сынып» әдісі, Fab Labs және Makerspaces құру, сондай-ақ университет негізінде инкубаторларды дамыту. Әдістердің, идеялардың, техникалар мен құралдардың молшылығына қарамастан, білім беру инфрақұрылымының оңтайлы компоненттері мен ең тиімді құралдарын анықтайтын әмбебап формула әлі де жоқ. Бұл мәселелер «зұлым» проблемалар ретінде сипатталады — күрделі, екіұшты және көпқырлы.

Дизайн-ойлау әдіснамасы «білім кеңістігінен» «тұжырымдамалық кеңістікке» өтуге мүмкіндік беріп, алынған инсайттарды тиімді қолдануды қамтамасыз етеді. Бұл жұмыста жоғары білім беру саласында тиімділігін дәлелдеген кеңінен танылған тәсілдер мен құралдардың жан-жақты талдауы ұсынылған. Сонымен қатар, зерттеу дизайн-ойлау әдістерінің бірі — «кабинеттік зерттеу» арқылы болашақ ғылыми зерттеулерге шабыт беруді мақсат етеді. Осы тәжірибелерді сыни тұрғыдан талдай отырып, жұмыс needfinding әдісінің тиімділігін және оның университеттердің тұтастығын сақтап, олардың бастапқы миссиясына сәйкес болу әлеуетін бағалауға бағытталған.

Түйін сөздер: дизайн-ойлау, білім беру, басқару, инновация, білім берудегі қажеттіліктерді табу

ДИЗАЙН-МЫШЛЕНИЕ: ОБЗОР ПОТРЕБНОСТЕЙ В ОБРАЗОВАНИИ

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Современное образование отличается удивительным разнообразием. Университеты внедряют широкий спектр инновационных подходов, включая совместное обучение, перевернутый класс, создание Fab Labs и Makerspaces, а также развитие университетских инкубаторов. Несмотря на обилие методов, концепций, техник и инструментов, до сих пор не существует универсальной формулы, определяющей оптимальные элементы образовательной инфраструктуры или самые эффективные инструменты. Эти вопросы представляют собой «злые» проблемы — сложные, неоднозначные и многогранные.

Методология дизайн-мышления предлагает путь перехода от «пространства знаний» к «пространству концепций», обеспечивая эффективное применение полученных инсайтов. В данной работе представлен всесторонний обзор широко признанных подходов и инструментов, которые доказали свою эффективность в высшем образовании. Кроме того, исследование нацелено на вдохновение будущих научных изысканий с использованием метода дизайн-мышления, известного как «кабинетное исследование». Критически анализируя и оценивая данные практики, работа стремится изучить эффективность подхода needfinding и его потенциал в сохранении целостности университетов, а также в соответствии с их изначальной миссией.

Ключевые слова: дизайн-мышление, образование, менеджмент, инновации, поиск потребностей в образовании

Introduction. Design thinking extends the boundaries of traditional design by offering a universal methodology for solving “wicked problems” [1]. It is an analytical and creative process that involves experimentation, creating and prototyping models, collecting feedback, and refining solutions. It is applicable to a variety of disciplines, including education, business, and engineering [2]. Innovation in education is no longer limited to the introduction of new technologies or teaching methods. It is transforming into a process of co-creation of value that integrates people, culture and technology into a single ecosystem, where diversity and differences become the driving forces of progress [3].

Needfinding is a fundamental process for developing user-centered solutions. It involves learning what users cannot clearly express, but which is critical to a successful outcome [4]. Empathy is used to understand the user’s context and create solutions that truly solve their problems. It is important to focus on *hidden or implicit needs* that are difficult to identify using traditional methods. Analysis of current solutions and real user behavior helps not only to clarify the problem, but also to create innovative ideas based on existing scenarios.

Design thinking consists of three phases: *inspiration, ideation,* and *implementation*. In this paper, we will fully immerse in inspiration. The initial stages of design thinking emphasize a deep understanding of the problem through research and analysis. The key tools are empathy, studying best practices and conducting desktop research. This process helps to reveal hidden aspects of the problem, study successful approaches of others and form a well-founded direction for further prototyping and testing of solutions [5].

In this paper, we will dive into the context of the problem by understanding the needs and motivations of users. This will allow us to create a basis for an effective solution based on real data, not assumptions. Studying best practices and successful cases in similar areas allows us not only to determine the current level of standards, but also to be inspired by innovative solutions. This creates a basis for identifying areas that can be improved. With empathy we will reveal hidden or insufficiently studied aspects of the problem to provide a foundation for generating ideas that will truly be based on user needs and real data [6].

Main part. Learning is a process that requires *flexibility* and an *eclectic* approach that integrates elements of behaviorism, cognitivism, and constructivism. *Behaviorism* views learning as a change in observable behavior caused by a response to specific stimuli and reinforced by external influences. *Cognitivism* focuses on mental processes such as thinking, problem solving, and information processing, paying attention to how learners perceive, organize, and store knowledge. *Constructivism* views learning as a process of creating meaning through personal experience. Learning occurs in a context where knowledge is not transmitted but constructed by learners based on their experiences and interactions. Effective learning, however, requires an integration of approaches that match the cognitive needs of the task and the knowledge levels of learners. Behavioural strategies are effective for basic skill acquisition, cognitive methods support problem solving, and a constructivist approach is indispensable when working with ill-structured tasks that require critical thinking and independent interpretation of knowledge. Undoubtedly, modern educational systems increasingly require a shift away from traditional learning models to more dynamic, interactive, and human-centered approaches. Therefore, educational designers should ask not "Which theory is best?" but "*Which theory is most effective in developing the acquisition of specific tasks by specific students?* [7]"

At the same time, collaborative learning among students, based on the exchange of experience and joint problem solving, is becoming a key element of modern educational practice. Approaches such as *collaborative learning* and the use of educational spaces stimulate the social construction of knowledge and contribute to the formation of sustainable skills of interaction and creativity. Constructivist and collaborative approaches are linked, creating a synergy that stimulates the development of critical thinking, creativity and cooperation skills in students [8].

Collaborative learning is relevant in the context of the modern educational process, as it meets the key challenges of the 21st century. In an era when learning is becoming increasingly focused on the development of social and professional competencies, this approach ensures not only academic success, but also forms critical skills such as cooperation, mutual support and adaptability. The study by Laal & Ghodsi emphasizes the importance of moving from an individualistic and competitive approach to a cooperative one, which is especially relevant for creating inclusive and human-centered educational systems. This helps students realize the importance of mutual support and responsibility, as well as develop critical thinking and problem-solving skills through constant interaction and discussion [9].

Active collaborative learning, supported by social interactions and student engagement promotes knowledge sharing and collective discussion of ideas as stimulates the development of critical thinking, social responsibility and problem-solving skills, which makes the learning process deeper and more effective [10]. Collaborative learning has a significant positive impact on the development of students' critical thinking skills. It creates an *environment* in which students actively exchange ideas, discuss and analyze complex issues, which contributes to their cognitive development [11].

Of course, the environment plays a key role in the success of any educational process. The environment can be identified in different manifestations and be physical, digital, hybrid. Often, in higher education, the environment is considered in a broader sense, which includes both physical space and social interaction and cultural aspects. Hira & Hynes in their study offers a conceptual model based on three aspects: people — participants, including students, teachers and the community, who form unique cultural and educational conditions in each space; means — the tools, technologies and materials used, which are adapted to the goals and context of the educational space; and activities - a variety of educational events, from prototyping and experimentation to creative tasks, which are aimed at developing skills and achieving learning goals, which help create the best educational experience through *makerspaces* [12].

Based on the philosophy of constructionism,

makerspaces are unique learning environments where students use physical objects to co-create knowledge. Indeed, the culture of makerspaces in higher education is not limited to access to modern equipment, but represents more: the integration of space, community, and educational programs [13]. These spaces foster social constructivist learning environments where ideas are generated and developed through interaction, negotiation and collaboration. The teacher acts as a mentor, blurring the boundaries between teacher and student. This methodology supports deep immersion in the educational process, making learning active and personalized, which is especially important for preparing students for modern challenges [3].

Mersand, in his research on *makerspaces* and *Fablabs*, finds that such spaces democratize access to tools, ideas, and learning processes, allowing participants to become not only consumers but also creators of knowledge [14]. However, the analysis shows that most studies focus on practical and technological aspects, leaving issues of inclusion, impact on educational outcomes, and assessment methodologies without due attention.

But at the same time, Fablabs and Makerspaces play a key role in rethinking educational approaches, especially in the context of global challenges and changes. As unique educational spaces, they develop as digital skills, as key entrepreneurial competencies of the 21st century. However, full development of skills is only possible with clearly structured educational programs aimed at entrepreneurship [15]. Often such educational practices are focused on the creation of artifacts (products) through practical learning, where the emphasis is placed more on the process and result of creation than on the conscious development of skills [16]. Also, such FabLabs are an excellent example of a global ecosystem, for example, the FabLab Network is a global network of laboratories, including more than 3,000 laboratories, uniting students, engineers, designers and entrepreneurs to jointly solve problems and share knowledge.

However, in a Science for Policy report by the Joint Research Centre, three unique aspects of makerspaces are highlighted that make them particularly attractive for educational purposes [17]. First, makerspaces bring together traditionally separate disciplines such as *science, technology, engineering, arts, and mathematics* (STEAM). This allows for interdisciplinary connections, critical thinking, and creativity. Second, participants solve practical problems, which helps them acquire knowledge and make sense of it through real-world experience. This promotes both deliberate and incidental learning. Third, makerspaces provide a variety of learning formats, from peer learning, peer coaching, to individual mentoring and hands-on workshops.

According to the report, by 2034, Makerspaces could evolve into four key areas: as educational spaces integrated into schools and universities for hands-on learning; as a methodology focusing on a project-based approach and solving real-world problems; as communities that bring together people with different backgrounds to co-create and share knowledge; and as a vital skill that develops students and professionals with the creativity, innovative thinking, and entrepreneurial skills needed to succeed in a dynamic world. Each scenario highlights how Makerspaces can be more than just spaces, but also a strategy, tool, and means to achieve educational goals.

Co-curricular activities such as *entrepreneurship competitions*, *mentoring programs*, and *incubators* have a significant impact on startup activity by providing students with hands-on experience and opportunities to build social networks [18]. Modern university campuses are successfully transformed into *entrepreneurial ecosystems*. Campuses can serve as modern *"frontiers"* — spaces where entrepreneurs can experiment, leverage resources, and build innovative companies [19].

Universities create educational ecosystems that support interactions between the academic community and small businesses, contributing to regional economic development. This helps to simultaneously improve the innovation potential of Small and Medium Enterprises (SMEs) and increase the employability of graduates through University-Based Incubators (UBIs) and student internships [20].

Furthermore, *peer learning* provides unique cognitive and social benefits. Through collaborative discussion, assessment and feedback, students not only strengthen their knowledge but also develop critical thinking, reasoning and self-reflection skills [21]. Despite the active diversity of teaching methods, there is a need to apply innovative methods of learning support that focus not only on the analysis of current results, but also on building strategies for future development. Incorporating both *peer feedback* and *peer feedforward* into the collaborative learning process significantly improves the quality of argumentative essays, cognitive assimilation of material and the development of critical thinking skills. The peculiarity of peer feedforward is that it helps students focus on prospects and strategies for achieving goals, and not only on the current work, which makes the learning process more future-oriented and productive. This approach is especially effective in online environments, where students can interact anonymously, minimizing social biases and increasing the depth of cognitive processing [22].

Subsequently, providing students with opportunities to engage in peer feedback improves their academic performance, and also promotes the development of self-reflective skills. Peer feedback transforms the role of the teacher from a ”knowledge carrier” to a ”facilitator”, allowing students to take responsibility for their learning and become active participants in the educational process. By teaching students, the skills to give and receive feedback, it is possible to create a more dynamic and supportive learning environment, where mistakes are perceived as opportunities for growth and interactions between students become the main tool for learning [23].

In addition, *peer-to-peer learning* is becoming especially relevant in the context of increasing student numbers and limited resources in higher education. It supports the movement towards interactive and human-centered teaching methods, replacing traditional lectures with more active and involved approaches. Peer-to-peer learning is effective for developing metacognitive skills such as self-reflection, learning management, and autonomous learning. Students, taking on the role of ”teachers”, not only learn the material at a deeper level, but also develop critical thinking, communication skills, and the organization of their own learning activities. The teacher takes on the role of a facilitator, guiding students but allowing them to control the learning process themselves. Peer-to-peer learning meets the challenges of the 21st century, and this correspondence repeatedly emerges in various sources [24], [25], [26], [27].

At the same time, structured interactions, an active role of course organizers, and design of materials with clear invitations to participate are critical to successfully engaging students in online learning, where Peer-to-peer learning will be very valuable and will help to properly build an online platform [8]. Peer-to-peer learning is particularly effective when integrated as a complement, considering the needs of students and specific educational contexts. This approach helps reduce anxiety, improve student engagement in the educational process, and create learning communities [29].

Communities of practice are a powerful tool for stimulating learning through knowledge sharing and collaborative problem solving in a professional environment. They are formed organically and are based on social interaction, support and mutual learning between participants. These communities allow combining formal and informal learning, integrating practical experience and theoretical knowledge. An important aspect is their ability to support the development of professional identity and collective intelligence, which is especially important in the context of a rapidly changing information space. Hara in his research emphasizes the need to move away from the traditional approach to learning based on top-down knowledge transfer in favor of creating supportive and interactive learning environments [30].

Communities of practice are especially valuable in organizations where it is important to preserve and disseminate *tacit knowledge* such as professional histories, contextual decisions, and collective experience. This knowledge is

difficult to formalize because it is transmitted through experience, context, interaction, and observation. It includes intuition, practical skills, social interaction, professional ”tricks,” and deeply rooted understanding of work processes. Tacit knowledge forms the basis for sustainable competence growth. It is retained within the community even when members change. It also helps to develop a deep understanding of the profession that goes beyond standard training materials. Tacit knowledge becomes a key asset not only for personal growth but also for creating collective intelligence, making it central to the development of successful communities of practice. Tacit knowledge is a central element of professional competence, but due to its nature, it is difficult to transmit through traditional educational methods. Tacit knowledge plays a central role in our ability to understand and act in the world, despite its inaccessibility to full verbalization. Given that we live in an era of active digitalization and automation, the very idea that not all knowledge can be encoded or formalized is key to understanding the limitations of modern technologies such as artificial intelligence [31]. Attempts to formalize tacit knowledge can distort its essence, since it is linked to context and intuitive perception. It is transmitted through social interaction, observation, mentoring and practical activities, which makes it especially important in education [32].

Gafney & Varma-Nelson in their study *Peer-Led Team Learning* (PLTL) describe an innovative pedagogical model that integrates student-centered active learning into the educational process through specially organized workshops led by students [33]. An important feature of PLTL is the role of workshop leaders, who act as equal partners rather than authority figures, facilitating the creation of an informal environment for in-depth study of the material. The PLTL program has proven its effectiveness in more than 100 educational institutions, including universities, colleges and research centers, reaching over 20,000 students annually. It allows students to work in small groups, where they can discuss complex topics, solve problems and deepen their understanding of key concepts through cooperative efforts.

PLTL emerged as a response to the need to improve student engagement in STEM (Science, Technology, Engineering, and Mathematics) subjects. Its implementation has shown that peer-based models can improve academic outcomes and create a culture of collaborative learning. An important element is the involvement of peer leaders who guide groups of students, helping them to solve problems together and deepen their understanding of the material. The supportive environment of the workshops helps students to participate in learning without fear of failure, which increases their confidence and motivation, which contributes to an inclusive environment [34].

Certainly, peer learning is effective through two key formats: cooperative learning and *peer tutoring*. Successful peer learning requires a clear structure for interactions that teachers create. Principles such as positive interdependence, individual responsibility, and group engagement ensure constructive social interactions and promote deeper learning. Peer learning techniques such as Jigsaw, Peer Tutoring, Constructive Controversy, Reciprocal Teaching, Think-Pair-Share, Collaborative Learning Groups, and Peer Assessment, as well as approaches such as Structured Academic Controversy and Numbered Heads Together, promote active student engagement by encouraging collaboration, critical thinking, and individual responsibility. Methods such as Learning Together, Team-Assisted Individualization, and Group Investigation further deepen understanding through collaborative problem solving and group reflection. Together, these strategies create a dynamic and inclusive learning environment, enabling students to deepen their knowledge, develop key interpersonal skills, and confidently contribute to collective learning outcomes [27].

Moreover, in the context of modern education, focused on the development of social and professional competencies, the integration of *service learning* is becoming extremely relevant. This approach not only combines theoretical training with practical experience, but also helps to strengthen the connection of universities with

communities, develop students' social responsibility and develop skills for solving real problems. Service learning is especially in demand in the context of human-centered educational systems, where the emphasis is on the individual needs of students and their role as active participants in social change. Service learning offers an effective model for integrating theory and practice, promoting the development of students' skills, their social responsibility and partnerships between universities and communities [35].

For example, in research universities, service-learning is not only a pedagogical approach but also a strategy that integrates teaching, research and service to society through integration into the mission of the university and the stimulation of research activities based on interaction with society [36]. However, there are significant pedagogical, political and institutional limitations to service learning in higher education [37].

Criticism of service-learning highlights the need to overcome the imbalance between universities and communities, ensure sustainability of projects and improve student training. It is important to consider the needs and perspectives of communities so that service-learning partnerships become truly mutually beneficial [38].

Also, universities, in an effort to support the development of their strategic initiatives and global challenges, resort to methodologies such as *project-based learning* (PBL) and *challenge-based learning* (CBL), which help develop transversal skills. CBL is a promising educational approach in higher education aimed at connecting theoretical knowledge with practical skills through solving real sociotechnical problems, involving students in interdisciplinary projects with the participation of academic and external actors [39]. CBL actively supports students' active participation in the learning process. Students take responsibility for choosing and solving a problem, which promotes their self-organization and independence. The role of the teacher changes: he or she becomes a facilitator who guides the process rather than transmits knowledge. CBL helps to unite different disciplines in solving complex, interdisciplinary challenges, such as sustainability, health, or technology. Students work in groups with diverse backgrounds, which improves communication and co-creation skills. However, despite the popularity of CBL, the methodology is often applied without a clear theoretical basis [40]. However, its ability to connect academic learning with practical problems makes it a promising tool for preparing students for today' s global challenges. CBL represents an evolution from problem-based learning, where the focus shifts to complex, interdisciplinary problems that require the participation of students, teachers and external stakeholders. A key element of CBL is not only learning through solving social and technological problems, but also the need for a systems approach [41]. Therefore, this methodology is often combined with other, more systematic approaches. For example, Charosky et. all in their study demonstrates the effectiveness of using Challenge-Based Education in combination with the design thinking methodology, which actively stimulates innovative thinking in students [42].

The world is changing rapidly and a lesson in a classic lecture format, where the teacher delivers a monologue, is almost of no value anymore. The pandemic has shown that methods such as *flipped teaching*, especially in online and blended formats, are ideally replacing traditional lectures with active and student-centered classes. Innovations such as e-flip and hyflex demonstrate its adaptability and potential for expanded use in the future. Flipped teaching changes the role of the teacher from a "sage on stage" to a "mentor and facilitator", increasing student responsibility for their learning and improving results [43]. The positive impact of the flipped approach is not only on the availability of materials, self-organization, but also on the independent pace of study. Which is especially important for a more customized and individual approach for each student [44]. The method is especially useful for disciplines that require a deep understanding of theory and its practical application, such as STEM. But despite all the advantages of flipped classrooms, it is worth considering that students are often not motivated enough to complete independent study [45].

The literature is full of successful examples, approaches, practices and methodologies for creating a better educational experience, but nevertheless we cannot take all of them and implement them in one educational institution. There is no coherence between them, there are no rules of the game, and we cannot implement inconsistent elements in a single university ecosystem. Although there is a tendency to oppose the traditional university model — *unbundling*. This concept means dividing traditional university functions, such as teaching, research, assessment, certification and student support, into separate services that can be provided by different organizations or platforms. Competition forces universities to follow this path, but the process must be carefully adapted to avoid undermining the fundamental goals of education. Unbundling can lead to *"hyperporosity"* of university boundaries, where the connection between them and society becomes so strong that the space for long-term academic research that is not focused on immediate results disappears. [46].

Conclusion. Disruptive educational institutions have moved away from traditional teaching and enable students to become active participants in their learning, develop key 21st century skills, and prepare for the challenges of a rapidly changing world. Design thinking is becoming the foundation for developing 21st century skills, including critical thinking, creative problem solving, and collaborative interaction. It integrates technology and real-world problems into educational processes, giving students the opportunity to develop metacognitive skills and adapt to the complex challenges of the future [47].

Knowledge creation spaces can be divided into social, cognitive, and structural factors [48]. Design thinking is particularly successful in addressing social and cognitive aspects, creating a trusting environment for idea sharing, analysis, and synthesis, leading to collective knowledge creation. This process involves social interaction, external knowledge adaptation, digital communication, and application in practice.

In this paper, we reviewed existing concepts and examples, available knowledge to expand our understanding and experience. Razzouk & Shute confirm in their research that design thinking is not just a tool, but a holistic way of thinking that transforms uncertain tasks into structured possibilities by creating a relationship between the *knowledge space* and the *concept space* [2]. The knowledge space is a collection of all available knowledge that already exists at the start of the design. The knowledge in this space includes both scientific facts and practical information accumulated through experience. An important feature is that it is limited only to what is already known, which emphasizes the need to involve experts and study existing data.

Design thinking is based on an iterative process of moving from *creative concepts* to *validated knowledge*. This process involves ideation, refinement, and empirical testing, which transforms initial concepts into feasible solutions. Design thinking combines *empirical* and *interpretive* approaches to solve complex problems, integrating creativity and practical knowledge [49].

Design thinking is based on the transition from the Concept Space to the knowledge space. This process involves the transformation of concepts into tested and implementable knowledge. Design begins with the formation of concepts, which are gradually refined and tested until they become part of the existing knowledge space. The iterative process involves expanding the concept space through experimentation, prototyping, and feedback, which contributes to the continuous growth of the knowledge space. In the future research, we plan to further expand our knowledge space by engaging experts in the field of education and collecting information from key stakeholders. We will move on to the concept space, where we will consider not yet tested and true ideas and concepts based on our knowledge space expanded by the conducted research.

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