

# Prospects for the Development of Design Thinking of Higher Education Applicants in the Culture and Art Industry in the Context of Digitalization

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## Abstract

The rapid development of science, technology, and digital multimedia has made adjustments in all areas of design. Its ramifications and forms are deeply influenced by digital media, making new demands on teaching. A renewed society regulates new modes of teaching to produce applicants capable of adapting to the development of modern society and responding to the needs of the market. The article aims to present the impact of the development of modern digital media technologies on the teaching of modern fashion design at Kyiv National University of Culture and Art and to analyze the methodological problems of design thinking. The novelty of the work is the consideration of a new mode of teaching that is suitable for digital media art design from the perspective of design thinking methodology. The result of the work is the connection between the modes of design and the development of creative projects in the perspective of the model of homogeneous synthesis of the use of design thinking methodology and digitalization. The feasibility of the methodology synthesis is revealed in the results of the experiment, which involved 30 students from three faculties of Kyiv National University of Culture and Art. The groups took a combined bachelor's and master's degree course in design engineering, aimed at developing the best final project. Students combined this course with incorporating a design thinking approach. The best project was demonstrated by the group that focused the most on the use of design thinking and creativity and was guided in the design development by one of the basic components of design thinking, empathy. Taking the perspective of incorporating design thinking into the learning process can identify the next steps that can assess a future professional's life trajectory as well as address topics such as recognition, memory, and future development perspectives.

**Keywords:** methodology synthesis, engineering, design, digital media technology, learning mode, creative project

## 1. Introduction

### 1.1 Integrating Digitalization into Fashion Design Development

The development of digital technology provides new perspectives for design teaching, and the integration of multimedia into this process is becoming one of the most effective and pervasive means of teaching. Social development requires new types of fashion design talents, so new models for teaching and optimizing fashion design learning in the digital age must be built (Ejsing-Duun & Skovbjerg, 2019). Along with the maturity and popularization of computer technology, Internet technology, and wireless digital communication technologies, digital media has quickly emerged and become mainstream, providing people with mass information and high-speed communication platforms, affecting people, and learning, life, work, and even thinking (Hernández Leo, Agostinho, Beardsley, Bennet, & Lockyer, 2017). Digital media integrates different media, such as traditional print, television broadcasting, digital networks, and information coming from paper graphics and texts. All of this is gradually becoming digital information that is made available on various electronic devices through the integration of media. The changing medium requires

designers to possess a variety of subject matter knowledge as well as the ability to integrate and cross-pollinate acquired skills (Dittert, Thestrup, & Robinson, 2021). The problem of popularization and development of computer technology in software, hardware, and other aspects is very relevant to the creation of fashion design. In this context, the development of a new system for teaching fashion design is crucial, since this is an industry that is constantly experiencing innovation, and teaching fashion design faces ever greater demands. The newest and best way to solve this problem is to integrate design thinking to create new digital media fashion design (Perrotta et al., 2019). This allows students to be exposed to different design knowledge and to master powerful computer capabilities and technologies. Regarding expositions in the field, they need a homogeneous use of design thinking methodology and the latest technologies.

### *1.2 Formation of Design Thinking Methodology*

Much interest in creativity is associated with the problem of major changes in society and culture. Undoubtedly, in a static and closed system such a problem does not arise, but for an open, dynamic, and recursive design system it is constantly relevant.

Design thinking is defined as the attitude of the individual to assimilate new design techniques. (Goldschmidt, 2022) argues that it is a synthesis proposed by professionals in academic design studies and professionals working in business schools and in the consulting sector and that it is not always homogeneous. The authors who have devoted their writings to this topic (Mahato, Phi & Prats, 2021) question some fundamental aspects of design thinking, exactly as it is understood in contemporary interpretations. Different currents have influenced the formation of the theoretical foundations of design thinking. The discussion around this issue began in the 1960s. The first scientific developments in design thinking date back to the 60s and 70s. They generally focused on the form and design methods used in the design, and only later gradually focused on design thinking as a creative process (Voigt, Unterfrauner, Aslan, & Hofer, 2019). (Zhang, 2020) appeals to the expression of design thinking. Back at the end of the last century, design thinking was still perceived as a mastery of design development. However, it is along with the development of digital technology that the views change significantly. (Lor, 2017) prefers the expression design thinking emphasizing that design should become a discipline in its own right, especially scientific ones since the design is based on the instinctive process and on the designer's creativity. (Valentim, Silva, & Conte, 2017) view design thinking as a discipline that must contain design practice, that is, design mastery, in addition to theory. According to (Chou, 2018), the term design thinking originated in the academic field, but in the context of technological development, it should be referred to the concept of design because it refers more to the world of organizations and enterprises and the problems they face. The author (Oxman, 2017) explores the role of design thinking in this field. He puts forward ideas of design thinking to be developed not only among designers and organizations but also among public sector bodies. At the same time, attention turns to focusing on the design process as well as the typical designer's design thinking, and the question of whether and how the designer's personal design thinking can be used in other professional contexts (Parker, Cruz, Gachago, & Morkel, 2021) is raised. In the key of this paper, we solidify that design thinking is anthropocentric and highlight empathy as a necessary attribute among the qualities of the designer. We believe that the most effective tools for developing design thinking for higher education applicants in the arts and culture industry in the context of digitalization are design thinking methodologies with anthropocentric design skills and behaviors and their adaptation to design.

### *1.3 Problems in the Teaching of Modern Design*

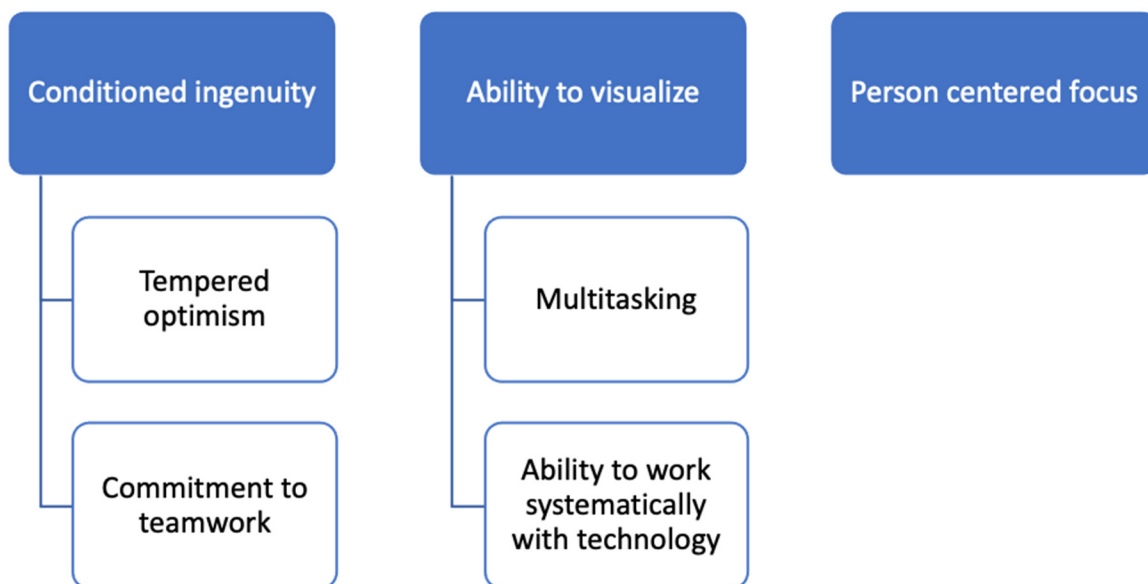
The popularization of computers, and computer-aided design has led to their use in almost all art and design courses. Computer technology makes fashion design more efficient and faster, in addition, its use helps to achieve brilliant effects that cannot be achieved by hand painting (Chen, Albert, & Jensen, 2022). However, in addition to the advantages of extensive use of computers, some disadvantages have also been found. Students focus entirely on computer effects experiences and powerful computer functions while ignoring subjective thinking, their own creativity, and design thinking. The arts and culture fields offer a wide variety of design software courses, ignoring the basic purpose of learning the art of computer design (Chen, Lapolla, & Hahn, 2020). It seems that the art and fashion design curriculum positions the talent training plan as training skilled computer software operators. However, in our view, the primary goal of design art training should be creative activities that define the various qualities of objects, processes, services, and systems throughout the life cycle of applicants. Design, as central to the innovative humanization of technology, is crucial to economic and cultural exchange (Chai, Hwee Ling Koh, & Teo, 2019). It identifies and defines structural, organizational, functional, expressive, and economic connections for social ethics first, that is, increasing global sustainability and environmental protection; for the benefit and freedom of humanity; for the formation of end-users, producers, and market actors, which in turn actualizes cultural diversity under globalization

(cultural ethics) (Albay, & Eisma, 2021). The purpose of this paper is to prove the feasibility of developing design thinking for higher education applicants in the field of culture and art in the context of digitalization. The task: to describe general theoretical statements of the phenomenon of design thinking in science; to demonstrate that the model of homogeneous use of design thinking methodology and the latest technologies on the example of working with students is productive; to explain in detail the advantages of using the synergy of methods and their advantages. At Kyiv National University of Culture and Art, academic programs are aimed at developing design talents, strengthening professional knowledge of art and design, and powerful artistic and cultural achievements. The teaching of computer design is not just a part of teaching art and design, but a foundation of solid professional knowledge using methodology.

## 2. Methods

Design thinking is primarily a design methodology whose goal is innovation and is based on logical and creative processes. However, it is not solely a process; the term also expresses the strategies used by designers in designing, which in turn is the product of their creative thinking. The term design thinking usually reveals the creativity and methods of designers. A new model of homogeneous synthesis of design thinking and the latest technologies used at Kyiv National University of Culture and Art is proposed. The homogeneous use of design thinking methodology and digitalization helps applicants to improve and accelerate the creative process, especially through constant repetition, and stimulates the innovativeness of products and services. A pedagogical program based on the integration of technology and content experience emphasizes the relationship between subject knowledge, pedagogy, and technical knowledge. The integration of this methodology stimulates subject matter pedagogical knowledge of technology integration and is a kind of reflection of the digitalization knowledge and abilities of the applicants. However, integrating digital technology into the classroom is not enough to develop courses for better teaching at a practical level. Only the interaction of subject matter, pedagogical, and technical knowledge and their combination with design thinking methodology translates into technical integration of design teaching. Design thinking is an important creative thinking skill because it can transform applicants' tacit knowledge into concrete products and reveal them through design. Thus, the use of a homogeneous model of teaching at Kyiv National University of Culture and Art allows: to change the concept of training talents of contemporary art and design, contributes to the optimization of the process of learning fashion design, to educate applicants with powerful abilities to innovative thinking and ignite their enthusiasm for art and creativity.

### 2.1 Participant (Subject) Characteristics



**Figure 1.** Basic Rules of Design Thinking

During the fall semester of 2022, three groups of students from different faculties of the Kyiv National University of Culture and Art were selected. Thirty students, aged 19-22 years old, were involved in the work. All students were informed that they were participating in an experiment, concerning the expediency of introducing design thinking into the curriculum. First, a survey was conducted. When asked if students agreed to become participants in the study, there was 100% positive consent - 30 students agreed. For the experiment, a combined undergraduate master's degree course in Design Thinking was selected as a required course for select departments: Faculty of Fashion and Show Business, Faculty of Distance Learning, Faculty of Information Technology Law, and Cyber Security. This course is designed to develop the best project to be offered to a specific organization (firm). During the fall semester, students combined this course with incorporating a design thinking approach. Selected groups studied design thinking and focused on developing creativity with a focus on the basic rules of design thinking (Figure 1).

The course recommended additional literature for students to read on their own, for a deeper understanding of the research process. In addition, successful examples of the application of design thinking by prominent designers were discussed, as well as work-reflection on the practice of designing a thesis. The experiences of the selected groups clearly noted that cultivating design thinking and creativity has learning potential.

### *2.2 Course Description*

The model for engaging design thinking in the educational process was implemented in a combined undergraduate master's course in design engineering. The course is interesting in that at the end students are offered a semester-long project on collaboration with external local organizations. Each group is required to write two projects for the committee to review. Students then form project teams and select one of the best work. This project work is anchored in a real need of a local company or organizations. Sometimes this need is not clearly articulated, rather the company wants to update their offerings, and they are asking for new, open, creative solutions. Students in the course received a manual from the instructors. All groups are required to attend regular lectures, workshops, and one-hour feedback sessions. They are assisted in conceptual design and prototyping by senior research assistants and a company representative. Selected groups must make interim presentations of their projects. The presentations are open to all interested parties. The course ends with a competition for the best design project. The competition is judged by an independent jury of three faculties and invited design professionals. Criteria for the jury are novelty, clarity of presentation, creativity based on basic design thinking dogmas, the potential impact of the developed prototype (relevance), validation of the prototype with users, and the overall design.

### *2.3 Using Design Thinking and Digitalization*

Groups were given the freedom to follow the design thinking approach or not. The main condition was to meet the general requirements of the course. Nevertheless, the instructors' task was to unleash creativity and design thinking in each group. At the beginning of the course, students were given lectures on design thinking, introducing the concepts of a set of practical skills. In addition, all external opportunities were used to motivate students, for example, for the best project, a financial proposal and a business plan for the implementation of the proposed innovation were supposed to be made. Of the three experimental groups, only two chose to work on a project involving the latest technology and design thinking. The two groups from the Faculty of Distance Learning, Faculty of Information Technology Law and Cyber Security made it to the final round. The proposed project development tasks were defined and distributed by the organizations. The first group had to find new application domains for existing technologies; the second group had to develop new programs using new technologies, and the third group used old programs and old technologies.

## **3. Results**

### *3.1 The Performance of the New Learning Model*

The group that won the final project competition worked with the latest technology - the faculty of Information Technology Law and Cyber Security. The students worked with complex web software used in the production of goods and services. The advantage was the use of design thinking and creativity. The group benefited from the inspiration of one of the three basic components of design thinking, empathy. This multifaceted construct, which includes emotional recognition, dominant feelings, and perspective-taking, was unfamiliar to many students. Although students were used to doing user research, they did not attempt to take a user seat. Part of this may be due to the notion that including personal experience would increase subjectivity in the study. Despite this, the students quickly appreciated the advantage of empathy and creatively applied this basic element of design thinking to their project conceptualizations. The group from the faculty of Information Technology Law and Cyber Security had to make a product that could be used in the waiting room of a pediatric dental clinic. As a result, the group developed a design for a leapfrog-driven,

LED-illuminated dental bureau. This was a great solution in terms of squeezing children when going to the dentist (jumping is fun, the water acts calming, and the multicolored lights keep children interested). This project clearly demonstrated the students' ability to use a synthesis of methodology. Such studies have already taken place in the scientific-cultural pedagogical discourse. The reason for this is the contradiction between the results of using design thinking. Researchers have debated whether design thinking provides confidence in the future professional or generates an unfounded and mistaken notion of confidence resulting from the actualization of the creative component. Specifically, Rao, Puranam & Singh (2022), note that design thinking at the fundamental (hard-skills) and mental (soft-skills) levels provides confidence in the knowledge and skills of future cultural professionals.

### *3.2 Reflections on the Feasibility of Using a homogeneous Synthesis of Design Thinking Methodology and Digitalization in the Training of Higher Education Applicants in Culture and the Arts*

#### 3.2.1 Changing the Concept of Preparing Talented Applicants for Contemporary Art and Design

Digitalization cannot replace the human brain, the computer is only a technological tool, and the leader in design is still human representation. In the new era, applicants in design and art must have an aptitude for artistic design. Technology and art complement and at the same time are capable of limiting the work process. Undeniably, the support of computer digital technology is inseparable in the artistic process, but creativity is a powerful tool for creating an artistic design. Designers must be proficient in computer digital technology to fully manifest the creativity of art design and get the best creative effect. The teaching of art design should not only adapt to the trends of the modern market economy but also to stimulate the artistic inspiration of students to gain skills to use new equipment and technical tools, and enhance the comprehensive quality and professional level of art.

#### 3.2.2 Optimization of the Process of Teaching Artistic Design

According to the cognitive differences of applicants in design and art, the characteristics of learning content, and their ability to design and design, a variety of media should be integrated to optimize the combination to present rich audiovisual effects involving design thinking and creative approach. With training and work and the possibility of failures in various hardware, and equipment can be reduced, the speed of presentation is very high, and the original graphics can last up to one second, but it is no substitute for human influence and charisma. The synthesis of design thinking and digitalization will diversify art and design learning and enhance the generation and transfer of new information in the learning process, which in turn can optimize the learning process and make it more efficient.

#### 3.2.3 Developing Applicants' Good Capacity for Innovative Thinking and Igniting Enthusiasm for Active Creativity

An interest in creative work involving design thinking methodology and combining it with digitalization sets the stage for the creation of art. The creative process in design and engineering needs inspiration, and inspiration comes from the designer's artistic interest. This interest can often stimulate applicants' learning motivation and develop imagination. Applicants can find inspiration through the exploration of their own experiences. Design thinking helps to free the mind, to create inspirationally, to view one's surroundings, and to explore unusual things in a normal technological mode. There is a problem in art and design thinking when applicants cannot fully express their creativity; they are guided only by automated clichés. It is up to teachers to encourage them to fully express their creativity, not necessarily comprehensively, but gradually. In this aspect, the methodology of design thinking is defined and tested while there is. Thus, in the process of teaching artistic and design abilities, teachers should not only develop the skills and application of various software tools but also enhance the aesthetic literacy of applicants through design thinking. This reveals the creative abilities of applicants, expands their knowledge and vision, and cultivates a new breed of talent in design and engineering with strong computer practical abilities and abilities of independent creative thinking.

The educational model is being updated: from design thinking to design knowledge (Chon & Sim, 2019). We can state the reorientation from traditional educational paradigms to innovative formats. With such theoretical and methodological attitudes, the use of ICT is relevant, which will stimulate:

- design thinking that prioritizes learning strategies;
- design knowledge that provides for practical implementation of creative skills.

Design thinking is important for cultural professionals because such a methodology develops creative approaches not only to solving but also to posing a problem (Wible, 2020). This aspect is often overlooked, but it is important given the information and digital format of education. Digitalization implies the dynamism of all processes that accompany the educational process. In this context, there is an urgent need to focus on problematic moments. Design thinking as an effective methodology of combining logical and creative components acts as a promising model with the help of which the challenges and threats are clearly formulated.

#### 4. Discussion

Design thinking is an anthropocentric process that looks for solutions to everyday problems and creates innovation. The design has a very practical approach to creating new solutions; it allows learning by doing and uses feedback to replicate and prototype ideas. (Tomita & Maeno, 2018) see design thinking as necessary to help people form a knowledge system, guides people to identify connections between knowledge and practical problems, and thus builds the ability to create new knowledge to solve more complex problems. The context of using design thinking in teaching (Postlethwaite, 2022) appeals to the fact that teaching design thinking is about creating, developing, and adopting new knowledge frameworks to solve the problems they encounter during the learning process. It is solidified that such knowledge should not only be pure theoretical knowledge or practical knowledge, but also a new type of knowledge generated by the synthesis of the homogeneous use of design thinking and digitalization. (Orr & Shreeve, 2017) reveal design thinking as the ability of teachers and applicants to continuously construct, generate, and create knowledge with an end result displayed in designer-created artifacts. Indeed, in this key, knowledge created by teachers is ultimately represented as different types of conceptual artifacts (plans, strategies, theories, viewpoints, models, etc.) based on a technologically integrated solution to learning problems. (Schmidt & Zarestky, 2021) speak to the needs for reforming teaching in design and art. The authors note that the design structure adopted by designers largely determines the validity of design outcomes. By adopting a design structure, designers can identify design problems and develop some initial solutions. In this context, (Purasmaa, 2018) notes that design structure is an important prerequisite for educators to strive for innovative learning involving design thinking methodology. We concur with this because if teachers cannot review existing design frameworks or create new design frameworks while facing complex challenges, it is nearly impossible to make a profound change in instruction. A review of the literature (Yen, Tu, Sujo-Montes, Harati, & Rodas, 2019) shows that along with the emergence of new forms of online learning and mobile learning, it has simply become necessary to find innovative solutions by engaging design thinking, divergent thinking, and convergent thinking.

McLaughlin, Chen, Lake, Guo, Skywark, Chernik, & Liu (2022) believe that the development of design thinking is inseparable from the experiences teachers have in real teaching practice environments, it guides them to create new knowledge and design frameworks, to develop solutions that adapt to different problem situations.

Henriksen, Gretter, & Richardson (2020) argue that five key dimensions of learning have lined up in the 21st century: the cognitive dimension, the metacognitive dimension, the sociocultural dimension, the performance dimension, and the technology dimension. Now central to these dimensions is the process of design thinking.

Design thinking is gradually finding its place in the system of skills that the higher education applicant acquires. For science and engineering majors, design thinking is classified as soft-skills or tangential skills (Lynch, Kamovich, Longva & Steinert, 2021). In culturally oriented majors, design thinking shapes hard-skills. If we consider innovative educational strategies based on the information and digital space, design thinking acts as digital-skills.

In recent years, design thinking has been successfully implemented in engineering education. Feedback retrieval and experimentation are methodological components that have demonstrated significant potential in a digitalized environment (Coleman, Shealy, Grohs & Godwin, 2020). These aspects are the most promising elements of a creative cluster in a cultural studies education system.

Interesting for further research is the intersection of design thinking and new technologies in augmented and virtual reality (AVR). Above all, the role of experience, which acts as a guarantee of sustainable development of knowledge, skills, and abilities of a creative nature, is actualized (Earle & Leyva-de la Hiz, 2021). Simulating the problems that the student must solve through a combination of logical and creative thinking is an effective motivating factor. Virtual reality, in this context, is the optimal setting for practicing the technique of applying design thinking.

Design and design thinking become important elements of creativity and innovation. Design thinking is implemented in many innovative formats of the educational process, in particular, and in integrated education of STEM-model (Li, Schoenfeld, diSessa, Graesser, Benson, English & Duschl, 2019).

The rapid digitalization of the 21st century means that educators need to start from the learning context of the present and consider the knowledge needed to design a digital curriculum and use design thinking to create the conditions, the limits of opportunity, such as the informatization of national education and higher education development policies.

#### 5. Conclusions

The analysis of this paper aims to reveal the necessity and feasibility of using design thinking in the context of digitalization in the field of teaching design and art. The synergy of methods is revealed in the results of the study,

where it is demonstrated that the selected groups who developed their own designs for the competition to produce a large number of ideas, showed knowledge, demonstrated the ability to manage uncertainty, to overcome obstacles without being stopped by intractable problems and the fear of possible failure. In the design process, design thinking showed a tendency to create pathways to success. It should be noted that this paper focuses on highlighting design thinking as a streamlined step that can help design and art aspirants develop better solutions and make better design decisions. This learning breakthrough is due to the fact that a homogeneous synergy of methods establishes a series of guiding questions as a meta-cognitive framework, instructing applicants in the key of design thinking.

In the context of further perspectives on this problem, we adopt the need for a specific course to teach design and art applicants the concepts and skills of design thinking. The studio strategy for this subject course should be cognitive learning, where applicants would work with expert faculty to develop design thinking through observation, reflection, and final design. However, integrating design thinking curriculum content is problematic in the digital age. Therefore, advocate the use of creative project design to integrate design thinking as a method to reform learning in the digital era.

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### References

- Albay, E. M., & Eisma, D. V. (2021). Performance task assessment supported by the design thinking process: Results from a true experimental research. *Social Sciences & Humanities Open*, 3(1), 100116. <https://doi.org/10.1016/j.ssaho.2021.100116>
- Chai, C. S., Hwee Ling Koh, J., & Teo, Y. H. (2018). Enhancing and Modeling Teachers' Design Beliefs and Efficacy of Technological Pedagogical Content Knowledge for 21st Century Quality Learning. *Journal of Educational Computing Research*, 57(2), 360-384. <https://doi.org/10.1177/0735633117752453>
- Chen, C., Lapolla, K., & Hahn, K. H. (2020). Adopting Real-world Learning Opportunities in Fashion Design Pedagogy for Undergraduate Students. In *Sustainability in Fashion*. Iowa State University Digital Press. <https://doi.org/10.31274/susfashion.11419>
- Chen, Y., Albert, L. J., & Jensen, S. (2021). Innovation farm: Teaching Artificial Intelligence through gamified social entrepreneurship in an introductory MIS course\*. *Decision Sciences Journal of Innovative Education*, 20, 43-56 <https://doi.org/10.1111/dsji.12253>
- Chon, H., & Sim, J. (2019). From design thinking to design knowing: An educational perspective. *Art, Design & Communication in Higher Education*, 18(2), 187-200. [https://doi.org/10.1386/adch\\_00006\\_1](https://doi.org/10.1386/adch_00006_1)
- Chou, D. C. (2018). Applying design thinking method to social entrepreneurship project. *Computer Standards & Interfaces*, 55, 73-79. <https://doi.org/10.1016/j.csi.2017.05.001>
- Coleman, E., Shealy, T., Grohs, J., & Godwin, A. (2020). Design thinking among first-year and senior engineering students: A cross-sectional, national study measuring perceived ability. *The Journal of Engineering Education*, 109, 72-87. <https://doi.org/10.1002/jee.20298>
- Dittert, N., Thestrup, K., & Robinson, S. (2021). The SEEDS pedagogy: Designing a new pedagogy for preschools using a technology-based toolkit. *International Journal of Child-Computer Interaction*, 27, 100210. <https://doi.org/10.1016/j.ijcci.2020.100210>
- Earle, A. G., & Leyva-de la Hiz, D. I. (2021). The wicked problem of teaching about wicked problems: Design thinking and emerging technologies in sustainability education. *Management Learning*, 52(5), 581-603. <https://doi.org/10.1177/1350507620974857>
- Ejsing-Duun, S., & Skovbjerg, H. M. (2019). Design as a mode of inquiry in design pedagogy and design thinking. *International Journal of Art & Design Education*, 38(2), 445-460. <https://doi.org/10.1111/jade.12214>
- Evens, R., Jost, R., & Evens, R. (1985). Economic and utilization analysis of magnetic resonance imaging units in the United States in 1985. *American Journal of Roentgenology*, 145(2), 393-398. <https://doi.org/10.2214/ajr.145.2.393>
- Goldschmidt, G. (2021). Critical Design and Design Thinking vs. critical design and design thinking. In *Different Perspectives in Design Thinking* (pp. 6-20). CRC Press. <https://doi.org/10.1201/9780429289378-2>

- Henriksen, D., Gretter, S., & Richardson, C. (2018). Design thinking and the practicing teacher: addressing problems of practice in teacher education. *Teaching Education*, 31(2), 209-229. <https://doi.org/10.1080/10476210.2018.1531841>
- Hernández-Leo, D., Agostinho, S., Beardsley, M., Bennett, S., & Lockyer, L. (2017). Helping teachers to think about their design problem: a pilot study to stimulate design thinking. In *International Conference on Education and New Learning Technologies*. IATED. 2017 Jul 3-5; Barcelona, Spain. Valencia: IATED; 2017. p. 5681-90. <https://doi.org/10.21125/edulearn.2017.2291>
- Li, Y., Schoenfeld, A. H., diSessa, A. A., Graesser, A., Benson, L., English, L., & Duschl, R. (2019). Design and Design Thinking in STEM Education. *Journal for STEM Education Research*, 2, 93-104. <https://doi.org/10.1007/s41979-019-00020-z>
- Lor, R. (2017). Design thinking in education: A critical review of literature. Retrieved from [https://www.researchgate.net/publication/324684320\\_Design\\_Thinking\\_in\\_Education\\_A\\_Critical\\_Review\\_of\\_Literature](https://www.researchgate.net/publication/324684320_Design_Thinking_in_Education_A_Critical_Review_of_Literature)
- Lynch, M., Kamovich, U., Longva, K., & Steinert, M. (2021). Combining technology and entrepreneurial education through design thinking: Students' reflections on the learning process. *Technological Forecasting and Social Change*, 164, 119689. <https://doi.org/10.1016/j.techfore.2019.06.015>
- Mahato, S. S., Phi, G. T., & Prats, L. (2021). Design thinking for social innovation: Secrets to success for tourism social entrepreneurs. *Journal of Hospitality and Tourism Management*, 49, 396-406. <https://doi.org/10.1016/j.jhtm.2021.10.010>
- McLaughlin, J. E., Chen, E., Lake, D., Guo, W., Skywark, E. R., Chernik, A., & Liu, T. (2022). Design thinking teaching and learning in higher education: Experiences across four universities. *Plos one*, 17(3), e0265902.
- Orr, S., & Shreeve, A. (2017). Introduction. In *Art and Design Pedagogy in Higher Education* (pp. 3-18). Routledge. <https://doi.org/10.4324/9781315415130-1>
- Oxman, R. (2017). Thinking difference: Theories and models of parametric design thinking. *Design Studies*, 52, 4-39. <https://doi.org/10.1016/j.destud.2017.06.001>
- Parker, M., Cruz, L., Gachago, D., & Morkel, J. (2020). Design Thinking for Challenges and Change in K-12 and Teacher Education. *Journal of Cases in Educational Leadership*, 155545892097546. <https://doi.org/10.1177/1555458920975467>
- Perrotta, F., Rosa, R., & Madonna, G. (2019). A study of clumsiness and sport. In *Journal of Human Sport and Exercise - 2019 - Summer Conferences of Sports Science*. Universidad de Alicante. <https://doi.org/10.14198/jhse.2019.14.proc5.18>
- Postlethwaite, S. (2020). Investigating Creative Processes and Pedagogy in the UK: Fashion Thinking. *Fashion Practice*, 1-10. <https://doi.org/10.1080/17569370.2020.1857077>
- Purasmaa, M. (2018). Studio Pedagogy as a Method in Textile and Fashion Design Education. Retrieved from <http://urn.fi/URN:NBN:fi:hulib-201809123137>
- Schmidt, K., & Zarestky, J. (2021). The State of Fashion Design Pedagogy: The Roles of Students and Instructors. In *14th International Conference of the European Academy of Design, Safe Harbours for Design Research*. Editora Blucher. <https://doi.org/10.5151/ead2021-152>
- Tomita, Y., & Maeno, T. (2018). Designing Structured Design Thinking Framework for Societal System Design in the Unknown Context. *Journal of Management and Strategy*, 9(3), 103-113. <https://doi.org/10.5430/jms.v9n3p103>
- Valentim, N. M. C., Silva, W., & Conte, T. (2017, May). The students' perspectives on applying design thinking for the design of mobile applications. In *2017 IEEE/ACM 39th International Conference on Software Engineering: Software Engineering Education and Training Track (ICSE-SEET)* (pp. 77-86). IEEE. <https://doi.org/10.1109/ICSE-SEET.2017.10>
- Voigt, C., Unterfrauner, E., Aslan, T., & Hofer, M. (2019). Design Thinking with Children. In *FL2019: FabLearn 2019*. (pp. 144-147). ACM. <https://doi.org/10.1145/3311890.3311912>
- Yen, C.-J., Tu, C.-H., Sujo-Montes, L. E., Harati, H., & Rodas, C. R. (2019). Using Personal Learning Environment (PLE) Management to Support Digital Lifelong Learning. *International Journal of Online Pedagogy and Course Design*, 9(3), 13-31. <https://doi.org/10.4018/ijopcd.2019070102>



Zhang, S. (2020). A Study on the Cultivation of Innovative and Entrepreneurial Talents of Fashion Design Major in the Colleges and Universities of China. *Frontiers in Educational Research*, 3(8).  
<https://doi.org/10.25236/FER.2020.030811>

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