A "Design Thinking Traits" Based Study on Project-Based Pedagogies in Architectural Education in the 21st Century

Inès Ikram Tlemsani, Laboratoire Innovation Formes Architectures Milieux, France
Vinicius Raducanu, Laboratoire Innovation Formes Architectures Milieux, France
Sébastien Chaliès, Laboratoire Interdisciplinaire de Recherche en Didactique, Education et Formation, France

The Barcelona Conference on Education 2024
Official Conference Proceedings

Abstract
The architectural profession in the 21st century faces new, unprecedented challenges. An equipped generation of architects with a large set of cross-disciplinary skills shall be required to rise up to these challenges. This study, rooted in the context of architectural education, analyses the impact of pedagogical approaches on the development of "Design Thinking Traits", collaboration, empathy and integrative thinking. While these traits have been recognized as important for design education, the measurement of their degree of integration in pedagogical practices is lacking. Utilizing a qualimetric methodology, we analysed 28 international design case studies, we identified 14 distinct "Project-Based Pedagogy" approaches and 12 cross-disciplinary skills that contribute to the enhancement of these traits. We found that a combination of critical pedagogy and transformative learning, implemented within a "Live Project" (experiential and social), fosters Cross-disciplinarity and nurtures the three "Design Thinking Traits". This study highlights the evolving roles, postures, and relational dynamics between different actors (teachers, students, external stakeholders) in these increasingly collaborative and interdisciplinary learning environments. It, also, underscores the underestimated skills, such as curiosity, negotiation, shared leadership and empathy. Overall, this research provides insights for educators and researchers seeking to shape pedagogical approaches to meet the evolving demands of architectural and design education in general, ensuring that students are equipped with the necessary skills to thrive in the dynamic landscape of the 21st century.

Keywords: Design Thinking Traits, Project-Based Pedagogies, Architectural Education, Cross-Disciplinary Skills, Design Education

1. Introduction: Design Thinking Traits and Project-Based Pedagogies: An Analytical Framework for Architectural Education in the 21st Century

The 21st century confronts the architectural profession with multifaceted challenges, mainly societal changes, technological advances, environmental concerns and the growing demand for socially responsible architectural practice, necessitating a profound transformation of the discipline and its education (Aydemir 2017; Blanckaert et al., 2019; Boudhraâ, 2020; Breed & Mehrtens, 2022; Charalambous & Christou, 2016; KamrowskaZałuska & Parteka, 2020; Salama & Wilkinson, 2007). Future architects need to develop much more than technical expertise (Freitas & Almendra, 2021; Holubchak, 2020); They must acquire a wide range of cognitive, metacognitive, interpersonal (Avsec & Jagiełło-Kowalczyk, 2021) and social (Breed & Mehrtens, 2022) skills to thrive in this dynamic landscape. Architectural education must be transformed by adopting pedagogical approaches that prepare students for these new realities (Salama, 2021). Despite the recognition of the importance of these cross-disciplinary skills (communication, empathy, teamwork, critical thinking, etc.), the existing literature does not offer structured methods for evaluating their integration into Project-Based Pedagogical[1] experiences, partly due to the lack of consensus on the classification of these competencies and the difficulties inherent in their measurement (Freitas & Almendra, 2021, p. 2).[2] The Project-Based Pedagogy[3] appears to be a powerful and adaptable tool for cultivating these skills. It is essential to recognize that it has evolved considerably since its first applications. Several key elements have enriched it. John Dewey (1910), a philosopher, psychologist, and educational reformer, emphasized experiential learning and its social dimension, while Bronwyn Davies (2016), a sociologist and educational theorist, explored uncertainty and freedom in learning. By immersing students in real-world design scenarios, this pedagogical approach fosters leadership, complex problem-solving and many other cross-disciplinary skills, preparing them for the ever-changing reality of architectural practice.

In this context, "Design Thinking",[4] increasingly recognized as essential for meeting the challenges of the 21st century in education (Luka, 2014; Shareef & Farivarsadri, 2020) is not just a reproducible methodology or a pedagogical approaches. It is a mindset and a way of thinking (Coleman, 2018), that is developed through experience (Ghonim, 2016), characterized by a set of traits such as collaboration, empathy, integrative thinking (Blizzard et al., 2015; Brown, 2008). These traits are observable via a set of competencies that

[1] This lack of structured methods is highlighted by several authors. For example, Freitas and Almendra (2021) note the absence of an evaluation system adapted to collaboration in education, while Katoppo and Sudradjat (2015) insist on the need to develop research methods that take into account the subjective and contextual nature of architecture.

[2] The lack of consensus on the classification of transversal skills is highlighted by the diversity of approaches proposed in the literature. For example, (Khodeir et Nessim, 2020) classify these skills into three domains – cognitive, interpersonal and intrapersonal – while Freitas and Almendra (2021) propose a classification into four categories: cognitive, meta-cognitive, interpersonal and social. Additionally, the measurement of these skills is often hampered by their subjective and contextual nature. As Habraken (2007) points out, architectural judgment, which is an essential transversal skill, depends on multiple factors (social, functional, political, etc.) and cannot be evaluated in a purely objective manner.

[3] "Project-Based Pedagogy" although mentioned as early as the 16th century in the context of architecture, saw its true theorization in the 20th century with the work of educationalists such as John Dewey, Maria Montessori and Jean Piaget. William H. Kilpatrick, a disciple of Dewey, laid the first concrete foundations of the project-based approach in 1918 in his book The Project Method. The project-based approach developed as a reaction to traditional teaching methods, deemed too passive and disconnected from the realities of life. It emphasizes active learning, concrete problem-solving and collaboration between students (Tessier 2021, 16)

[4] "Design Thinking" is a complex concept that can be understood both as a cognitive style specific to designers (Cross, 1982; Schön, 1983; Rowe, 1987; Lawson, 1997; Cross, 2006; Dorst, 2006) and as a general theory of design introduced by Buchanan (1992) in his article entitled "Wicked Problems in Design Thinking" as shown by Kimbell (2011) in "*Table 1: Different ways of describing design thinking*". (P 15). "*Design thinking is not a type of knowledge that can be taught theoretically, but rather is a skill that should be practiced and learnt through solving real-life problems (Lawson, 2005; Kimbell, 2011). Design education aims at producing mentalities that are capable of thinking originally and independently. It also aims at preparing qualified designers who can adapt*" (Ghonim, 2016)

demonstrate mastery of "Design Thinking", such as teamwork, creative thinking, leadership (Avsec & Jagiełło-Kowalczyk, 2021; Todoroff et al., 2021). It is within this perspective of a mindset expressed through specific competencies that "Design Thinking" offers a relevant analytical framework for measuring the degree of integration of the 12 cross-disciplinary skills identified in our study and grouped under the three following "Design Thinking Traits":[5]

> **Empathy:** "*Imagine the world from multiple perspectives (T.Brown, 2008), Think as a part of a team in a social process (Dym et al.2005) where design is socially situated (Schön 1983)*" (Todoroff et al. 2021). It goes beyond the mere consideration of "human" to extend to the "non-human" elements of design (the physical, social and cultural context) (Laplace 2023), and it is acquired through immersion, social interaction activities and participatory design methods (Holubchak 2020).
>
> **Integrative Thinking:** is a complex systems thinking that enables us to approach design problems creatively and holistically (Dym et al., 2005), taking into account all the dimensions of the problem (technical, social, environmental, economic, etc.), and mobilizing analytical, intuitive and imaginative skills (Toit et al., 2024).
>
> **Collaboration**: "Ability to work with many different disciplines and often have experience in more than just one field" to achieve a common goal. (Blizzard et al., 2015 as cited by Todoroff et al., 2021). It's a dynamic, interactive process that requires shared or distributed leadership, flexibility in adapting to challenges, and the ability to negotiate to reach consensual solutions.

The main objective of this study is to verify whether empirical observations, derived from case studies, confirm the hypothesis that certain pedagogical approaches foster the development of "Design Thinking Traits" in architectural education.

To achieve this we propose a qualimetric[6] approach to assess the integration of cross-disciplinary skills in a design studio pedagogical experiences. This method, based on the analysis of qualitative data, is particularly well-suited to the study of complex, subjective phenomena. Our research aims to answer:

> Which "Studio-Based Pedagogy" approaches best cultivate "Design Thinking Traits" in architectural education?

To answer this question, the study will:

- Identify "Studio-Based Pedagogical" approaches that address the notion of cross-disciplinary skills.
- Assess the degree of integration of each "Design Thinking Trait" into these pedagogical experiences.

---

[5] "Design Thinking Traits", represent a combination of common attitudes, skills and cognitive processes which caracterized "Design Thinking" found in different design disciplines, despite their specificities. These traits, summarized in "*Table 1 Design thinking traits based on literature*" (Todoroff et al., 2021, 2), come from the work of Blizzard et al. (2015) and Brown (2008).

[6] "Qualimetric Analysis" is a hybrid evaluation method that combines qualitative and quantitative approaches. In the context of our study, it is based on textual analysis (qualitative), and the use of a binary scoring system (quantitative). The combination of these two methods will enable us to identify correlations between pedagogical approaches and "D*esign Thinking*" traits in the design studio.

2. Literature Review: Evolution of Project-Based Pedagogies in 21st-Century Architectural Education

This literature review offers an in-depth overview of the current state of architectural education in the 21st century, highlighting the diversity of pedagogical approaches that foster cross-disciplinary skills. These approaches emphasize real-world problem-solving and collaborative competencies crucial in today's complex, interdisciplinary design landscape. Through our analysis, we identified 14 new variations in the evolution of Project-Based Learning (PjBL), as summarized in the table below. These variations reflect the adaptation of PjBL principles—such as experiential and student-centered learning grounded in real-world contexts—to address contemporary challenges, including the need for greater student autonomy, equitable power dynamics, and hybrid learning environments.

Table 1: Studio-Based Pedagogical Approaches:
Modern Evolutions of Project-Based Learning (PBL)

Pedagogy	Selected refrences	Specific Focus
Challenge-Based Learning (CBL) (n=2)	(Shareef et arivarsadri, 2020) (Acuńa et al, 2017)	Tackling real-world, complex issues with societal impact, often on a global or local scale
Competency-Based Learning (CBL) (n=1)	(Acuńa et al., 2017)	Focused on the acquisition and mastery of specific, measurable skills and directly applicable in a professional context.
Design Thinking (n=7)	(Avsec et Jagiełło-Kowalczyk, 2021)	Applying a human-centered design approach
Live-Project (n=3)	Breed et Mehrtens 2022 BLANCKAERT et al. 2019	Engaging in projects with real-world clients or stakeholders, often with specific deliverables
Design andBuild/Learning-By-Making (LBM) (n= 3)	BLANCKAERT et al. 2019 Delpire 2019	Integrating the entire life cycle of a building, from design to construction.
Inquiry & Research-Based / oriented Learning (n=5)	Nyka et al 2020 Charalambous 2016 Michael K. Jenson Abdelmonem 2014	Investigation, research skills and the production of new knowledge. emphasises learner autonomy, investigation, discovery and the development of critical thinking skills.
Service Learning (n=1)	Wan et al 2012	Active participation in solving concrete problems in the community, combining community engagement with the enhancement of citizenship.
Co-design Learning (n=1)	Boudhraâ 2020	Collaborative project design with equal participation of stakeholders, shared ownership and co-construction of knowledge and solutions.
Transformative Learning (n=1)	Breed et Mehrtens 2022	Encouraging self-reflection and critical examination to transform personal beliefs and perspectives of students
Game-Based Learning (GBL)/ Interactive playful learning (n=1)	HOLUBCHAK 2020	Using game to create immersive, engaging learning experiences that motivate creative problem-solving
Expansive Learning (n=1)	Kurjenoja et al 2019	Transforming practices, multi-stakeholder collaboration and managing contradictions to create new solutions to complex problems
CDIO (Concevoir, Développer, Implémenter et Opérer) (n=1)	Nyka et al 2020	Integration of the entire project life cycle, iterative experimentation, research through design, interdisciplinary collaboration and the integration of contemporary technologies.

ASTM (n=1)	Asefi et Imani (2018)	The development of critical and creative thinking through a structured and iterative design process, encouraging collaboration and interaction.
Project-Oriented Problem-Based Learning (PoPBL)	Wan et al 2012	Experiential and collaborative learning focused on problem-solving and student autonomy, applied to concrete projects embedded in the community

The dominant tendencies in architectural education for the 21st century are, mainly, characterized by:

2.1 Moving From a Teacher-Centered to a Student-Centered Design Studio Pedagogy

This transition shifts responsibility for learning to the students, making the process more active, engaging, and meaningful(Abdelmonem 2014; Asefi et Imani 2018; Boudhraâ 2020). Delpire (2019), Breed et Mehrtens (2022) and Bregger (2017) highlight the positive impact of involving students in practical, real-life projects that are useful to society. Delpire (2019) describes the "*Architecture Construite*"[7] workshop as an example of "*Pédagogie Ouverte*",[8] an immersive experience "beyond the walls" of the design studio focusing on participation, cooperation, self-management and transparency. Breed et Mehrtens focus on "Live Projects", an Experiential Learning that provides a rich and stimulating learning environment, encouraging social empathy, flexibility and curiosity in design and collaboration with municipalities and professionals on urban green infrastructure (UGI). Bregger illustrate Problem-Based-Learning (PBL) describing an interdisciplinary project to design a sustainable community centre. This type of project immerses student in a real context and confronts them to concrete ill-defined problems fostering the development of problem-solving skills, interdisciplinary collaboration and a transformative learning. All these approaches, despite their challenges, allow students to develop different cross-disciplinary skills which encourage intrinsic motivation, a sense of achievement and sustainable learning. In this context, the Teacher and Student roles must evolve.

2.2 Moving From Vertical to Horizontal Interactions/Power Dynamics

Horizontal interaction, the natural extension of Student-Centered Learning (SCL) transforms power dynamics within the design studio's pedagogy. By empowering students as active learners, we create a collaborative learning environment in real-life projects that fosters the development of critical thinking, creative thinking, communication, decision-making and team work skills. Boudhraâ (2020) illustrates this horizontal interaction through the co-design approach, as the driving force behind the co-evolution of the problem-solution space. This Approach involves the teacher as a facilitator and guide for collective reflection which encourages open communication and co-construction of ideas between him and the students and fosters empathy, flexibility, as students engage in meaningful problem-solving processes. Blanckaert et al. (2019) introduce the concept of 'transversal cooperation' in the context of a "Design & Build" educational project called "Garden of Experiences", promoting mutual learning where everyone is both "Teacher" and "Learner" in an embodied experience. This project encouraged the emergence of fluid, shared leadership illustrated by the roles of

[7] "Architecture Construite" is the name of the workshop meaning "Built Architecture". (Delpire, 2019).
[8] "Pédagogie ouverte" is the pedagogy used in the "Architecture Construite" workshop meaning "Open Pedagogy"(Delpire, 2019).

"Jexp'erts"[9], "Jexp'ats"[10] and "Jexp'claves",[11] where everyone can play their part and contribute to the development of a common project.

The concept of horizontal interaction can be extended beyond the teacher-student relationship to encompass multi-stakeholder collaboration. Wan Mohamad et al. (2012) describe "Service Learning", a pedagogical model that encourages students to collaborate with the local community, as illustrated by the Kuching affordable housing project. Kurjenoja Lounassaari et al. (2019) present "Expansive Learning" as a pedagogical model that emphasises that a bottom-up approach relies on strong collaboration between students, teachers, professionals, and local communities to effectively navigate challenges together. Both teachers and students must engage with empathy to deeply understand local community concerns, while flexibility allows them to adapt their strategies to meet the unique needs of their territory.

A project carried out in Cholula, Mexico enabled the students to familiarize themselves with local realities, understand the needs of the population and grasp the importance of protecting intangible heritage. Immersion in this specific context provided the students with a rich and meaningful learning experience.

The teacher plays a central role in this process as a facilitator. He or she encourages the active participation of each stakeholder, stimulates exchanges, guides reflections and negotiations, and ensures that learning is sustainable and deep. In a more collaborative, democratic and dynamic learning environment, and to achieve truly transformative learning, it is becoming essential to adopt hybrid pedagogies, combining several approaches as it will be confirmed later on by our qualimetric analysis.

2.3 Towards Hybrid Design Studios-Based Pedagogical Approaches

The landscape of architecture and design education in the 21st century is in a state of flux. It has become essential to move beyond single pedagogical approaches and adopt more holistic and flexible ones. This literature review highlights the increasing use of diverse combinations of pedagogical approaches in design studios to address the growing need for disciplinary openness and community engagement.

Hybrid pedagogies in design studios combine varied methods to enhance architectural education. Abdelmonem (2014) emphasizes interactive, practice-based learning, where students act as "researcher-contributors" fostering engagement and active knowledge construction. Avsec and Jagiełło-Kowalczyk (2021) highlight conceptual thinking and self-directed learning as key to cultivating creativity, digital skills, and collaboration. Charalambous and Christou (2016) advocate for interdisciplinary, crisis-responsive studios that leverage innovative tools and cross-disciplinary approaches. Similarly, Design Studio

[9] "Jexp'erts" refers to students who have previously participated in the "Garden of Experiments" project. The term blends "JExp'" with "experts" to highlight the experience these students have gained. With their prior involvement, they possess a deeper understanding of the project's approach and are able to mentor or guide new participants

[10] "Jexp'ats": This term refers to new participants in the "Garden of Experiences" project. The pun combines "Jexp'" with "expatriates", emphasizing their recent arrival in the project. They are considered the future "Jexp'erts".

[11] "Jexp'claves": This term refers to students benefiting from the organization set up by "Jexp'erts" and "Jexp'ats". The play on words combines "JExp'" with "claves", suggesting that these students hold the "keys" to effective action in the field without needing to consult the general coordinator.

Pedagogy: Horizons for the Future (2007) calls for adaptive studio models that integrate advancements in technology and address societal needs.

Hybrid studios promote disciplinary openness, preparing students to tackle complex global challenges through cross-field collaboration. They also encourage community engagement by incorporating real-world projects, involving stakeholders in the design process, and fostering socially responsible practices.

While these mostly combined approaches claim to foster cross-disciplinary skills, no empirical studies have measured their impact on integrating and developing the three "Design Thinking Traits" _ empathy, collaboration and integrative thinking which allow to achieve a transformative sustainable learning (Breed et Mehrtens, 2022). This study, despite its limitations, could strengthen understanding the role of these pedagogical approaches combinations in integrating "Design Thinking Traits" and encourage more rigorous empirical studies which might provide insights for educators and researchers seeking to adapt pedagogical approaches to the changing multiform demands of the evolving architectural education.

3. Methodology

This study aims to measure the degree of integration of each “design thinking trait” into different pedagogical experiences to answer the following question:

- Which "Studio-based pedagogy" approaches best cultivate "Design Thinking Traits" in architectural education?[12]

In order to achieve this objective, rather than using precise queries, an exploratory/iterative research methodology, structured in three phases_Searching, Screening and Evaluating_was conducted to systematically select a relevant corpus guided by clear inclusion/exclusion criteria (Table 2 & 3). Additionally, a qualimetric evaluation[13] was conducted to assess how effectively each of the 28 case studies incorporated cross-disciplinary skills linked to "Design Thinking Traits", thereby ensuring a robust analysis of the pedagogical approaches.

3.1 Study Corpus

3.1.1 The Searching Phase (Titles, Keywords and Abstract Full Reading)

The searching was carried out both in English and French using Google Scholar Database and applying specific inclusion/exclusion criteria (Table2). This initial search aimed to identify relevant documents dealing with project based pedagogical approaches in design/architectural education in the 21 St century, in particular those that can be linked with "Design Thinking" and "Competency-Based Education".

[12] The focus is not on evaluating whether these project-based pedagogies explicitly teach "Design Thinking" as a method, content, or pedagogical approach, but rather on examining the extent to which they foster a learning environment that promotes the acquisition of these three "Design Thinking Traits" decomposed on a set of 12 cross-disciplinary skills.

[13] "Qualimetric Analysis" is a hybrid evaluation method that combines qualitative and quantitative approaches. In the context of our study, it is based on textual analysis (qualitative), and the use of a binary scoring system (quantitative). The combination of these two methods will enable us to identify correlations between pedagogical approaches and "Design Thinking Traits" in the design studio (Karavaeva et al., 2016).

The following keywords were used with different combinations: "Design Studio", "Design Pedagogy", "Design Learning", "Design Thinking", "Project-Based Pedagogy", "Competency", "Skills", "Design / Architecture/ Architectural Education", etc. We selected every document based on the title, keywords and full reading of the abstract. This enabled us to accumulate 200 relevant documents (peer reviewed articles, books and book chapters, conference papers, thesis, etc.).

Table 2: Inclusion and Exclusion Criteria Applied for The Searching Phase

General Inclusion/exclusion criteria	**Description**
1-Main theme	Articles on architectural/design education.
2-Language	The article must be in French or English.
3-Publication date	The article must be published between 2000 and 2022.

3.1.2 The Screening Phase (Full Text Reading)

In the Screening phase, we focused on applying inclusion/exclusion criterion 4 to filter the documents further (Table 3):

Table 3: Inclusion and Exclusion Criterion 4 Applied for the Screening Phase

Specific Inclusion/exclusion criterion	**Description**
4-Description of teaching experiences.	The article must mention the Teaching Context, Skills, Pedagogical Approach and Objectives, Learning and Assessment tools, Working Environment, Status of the teacher/student, etc.

3.1.3 The Evaluating Phase (Full Text Reading)

In the Evaluating phase, we focused on applying inclusion/exclusion criterion 5 to filter the documents further (Table 3). This systematic approach allowed for a rigorous selection of articles that directly addressed our research questions.

Table 4: Inclusion and Exclusion Criterion 5 Applied for the Evaluating Phase

Inclusion/exclusion criterion	**Description**
5-Link with "Design Thinking Traits"	The document should describe how the pedagogical activities facilitate the acquisition of a diverse range of cross-disciplinary skills.

3.1.4 Reading and Annotation

All selected documents were read and annotated using Zotero software to extract the main themes and sub-themes addressed (Table 5) derived from Criterion 4 and 5:teaching context, competencies, pedagogical approach and objectives, learning and assessment tools, working environment, and the status of the teacher/student.

Table 5: Example of Extraction of Recurrent Data Collected From the Corpus According to Inclusion/Exclusion Criteria 4 and 5

Theme	Selected references	Context	Skills	Pedagogical Approach/ strategy	Teaching objectives and results
Collaboration and Empathy and Integrative Thinking *between the architecture and landscape departments and the local municipality*	Using "Live" Public Sector Projects in Design Teaching to Transform Urban Green Infrastructure in South Africa Christina Breed and Helge Mehrtens South Africa 2019	Real-life design studio project	Empathy Participation Communication Creative thinking1 Critical thinking Curiosity Flexibility Decision-making Negotiation Leadership Teamwork Problem solving	Experiential and social learning Transformative learning Interdisciplinary Collaborative learning SDL	The results show that real-life confrontation with a project in a challenging environment provides learners with essential tools to become effective agents of change. Sense of competence achieved by students (Breed and Mehrtens 2022, 13,14,15) The local municipality is satisfied with the experience
		Learning and assessment tools: study tour, technical workshop1, workshop, weekly critical session **earning environment :** social Dynamic, highly collaborative and interdisciplinary (internal/external) **Recruitment strategy:** voluntary participation **Learning framework :** Student-centered/active learner/teacher facilitator **Design Thinking:** explicit			

As a result of this exploratory/iterative research methodology, 26 documents (peer reviewed articles, books and book chapters, conference papers, thesis, etc.) encompassing 28 pedagogical experiences from over 20 universities across five continents (Figure 1) were selected for a qualimetric evaluation.

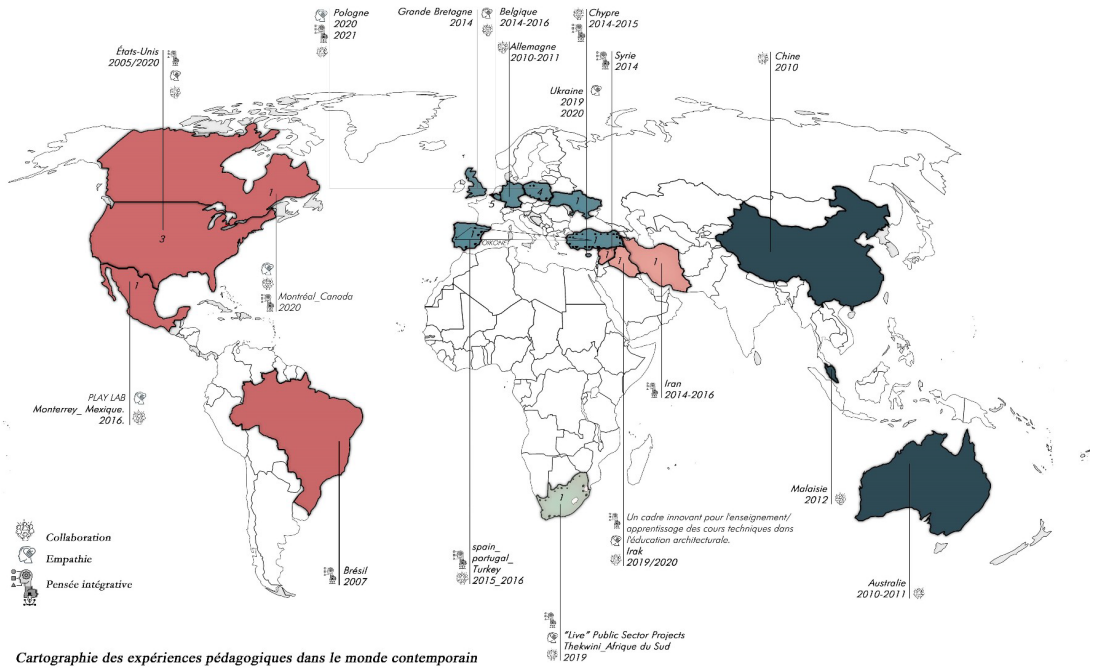


Figure 1: International Mapping of Scientific Document Selected on Studio-Based Pedagogy

3.2 Qualimetric Analysis

This analysis utilized a textual inductive approach, drawing on the qualitative coding and categorization methods outlined by Strauss and Corbin (1998), to identify relevant cross-disciplinary skills embedded in each educational experiment. The main aim of this analysis is not to develop an immediate theory, but to identify the cross-disciplinary skills present in the educational experiences analysed, link them to "Design Thinking Traits" and quantify their impact.

3.2.1 Identification of Cross-Disciplinary Skills

Through textual analysis of the 28 case studies, 12 cross-disciplinary skills were identified then categorized under two main "Design Thinking Traits": collaboration (Communication, Participation, Teamwork, Leadership, Flexibility, Negotiation) and integrative thinking (Problem-solving, creative thinking, critical thinking, flexibility, curiosity and decision-making). This categorization was based on the alignment of each skill with the conceptual attributes of these traits as represented in the literature (Table 6) and inspired from the scientific article "Soft Skills in Design Education, Identification, classification, and relations" (Freitas etAlmedraa, 2021). Empathy was not decomposed into specific skills. due to its complex, subjective, and relational nature (Avsec et Kowalczyk, 2021).

Table 6: Manifestation of Design Thinking Traits Through Associated Cross-Disciplinary Skills and Reports From Architectural Pedagogical Experiences

Design Thinking Traits	**Associated Cross-disciplinary skills**	**Textual analysis**	**Example**
Collaboration	**Communication Participation, Teamwork, Leadership, Flexibility Negotiation**	**1- Textual markers:** - Cross-disciplinary skills -Design thinking Traits **2- Narrative structure analysis:** - Description of the learning process. -Examples and testimonials **3-project impact assessment:** -Concrete results (Changes in student behaviour or perceptions) -Skills development as an outcome	–"*I might not have learnt exactly what Tec wanted me to, but I learnt how to* ***think****,* ***challenge****,* ***collaborate****,* ***listen****…* ***I am a better person"***[14,15] –"*For the students, the project created* ***rich social dynamics*** *and an* ***interplay of familiarity and uncertainty****, which aided* ***transformative learning****. The students' deeper learning indicates greater* ***social empathy****,* ***reconsidering the role of the profession****, greater design process* ***flexibility****, and learning and* ***valuing skills across disciplines.***"[16] –"*La* ***résolution des problèmes*** *s'est opérée directement in-situ, […]. Plus de* ***85 % des étudiants*** *ont trouvé les* ***échanges bons à très bons*** *au sein des groupes.", " **Agir puis réfléchir, c'est se poser les questions****[…]****sur les raisons de son action****…", "Observer: Jexp'rime, jexp'lore, jexp'érimente… sont autant de termes qui traduisent […] une relation sensible à l'être et à l'espace qui l'entoure.*"[17]
Empathy	**Explicit citation**		
Integrative Thinking	**Problem-solving Creative thinking Critical thinking, Flexibility Curiosity Decision-making.**		

3.2.2 Binary Scoring System

- The presence of the 12 cross-disciplinary skills was quantified by assigning a **score of one (1)** when it is possible to state with certainty that the skill is being targeted and developed,

[14]This statement suggests learning that goes beyond technical skills. The student has developed human qualities and cognitive, meta-cognitive, interpersonal and social skills which are essential in a social context of learning (Acuña et al., 2017; Blanckaert et al., 2019; Breed et Mehrtens, 2022)
[15]Quote from a Play Lab student (Acuna et al, 2017, p6.)
[16]Breed et Mehrtens, 2022, p. 1.
[17](Blanckaert, 2019)

within the context of the experiment, whether explicitly or implicitly.[18] while *a score of zero (0)* was attributed when the text provided no indication of the development of the skill. The attribution of a score (1) for *empathy* was based on the authors explicit statements of its integration.

- **The degree of integration** for each trait was calculated by summing the scores for all associated cross-disciplinary skills. This binary system provides a clear, concise, and objective assessment, facilitating comparisons across the 28 educational experiences.

The **Binary scoring system** used in this study provides an initial overview of the integration of "Design Thinking Traits" into different educational experiences. It makes it possible to compare approaches and identify those that seem most promising. However, it presents several limitations, notably publication bias, as authors tend to emphasize the positive outcomes of their research. As a result, there is a pressing need for further *in-depth empirical studies "in situ"*, including longitudinal data and more refined evaluation methods, to *fully assess the validity and reliability of the results.* For a more complete assessment of the impact of teaching approaches on skills development, it is necessary to combine more precise evaluation methods, qualitative observations and longitudinal studies that allow the evolution of skills to be tracked over several years.

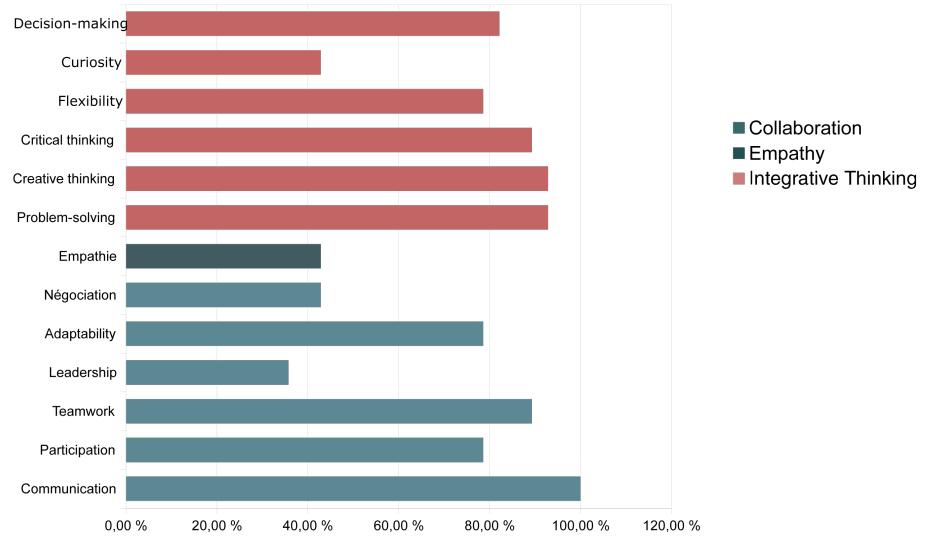
4. Results, Discussion and Implications

4.1 Identification of Overlooked and Highly Valued Cross-Disciplinary Skills

Through an in-depth textual analysis of the international case studies, we identified 12 distinct cross-disciplinary competencies that are cultivated through studio-based pedagogies. The results show that while skills such as communication (28/28), creative thinking, and problem-solving (26/28) are emphasized, others, such as empathy, curiosity, negotiation (12/28), and shared leadership (11/28), are often overlooked.

While curiosity, empathy, negotiation, and shared leadership are recognized as crucial transversal skills for enriching architectural design practices (Freitas & Almendra, 2021), their integration into pedagogical practices remains limited, highlighting a significant disparity between their theoretical importance and practical implementation. Among the 28 case studies analysed, only 12 explicitly addressed curiosity, empathy, and negotiation, while shared leadership was addressed in just 11. This gap can be attributed to several challenges, including the traditional dominance of technical knowledge in design curricula (Asefi & Imani, 2018; Avsec & Jagiełło-Kowalczyk, 2021; Holubchak, 2020), a lack of resources and time for integrating empathy, curiosity, negotiation, and/or shared leadership-focused activities, and the absence of reliable methods to assess them as a measurable outcome (Aydemir, 2017). A rigid hierarchical culture (Charalambous et Christou, 2016), where the teacher is the sole authority figure, often undermines opportunities for shared leadership and collaboration. Furthermore, the emphasis on teacher validation may discourage risk-taking and experimentation—critical components of curiosity and empathy. The lack of adequate teacher training on how to effectively teach these transversal skills presents another significant barrier, compounded by the absence of reliable tools and resources to assess these competencies, which further hinders their inclusion in the curriculum.

[18] The skill is not named directly, but its development can be deduced from the learning context, the activities described or the results obtained via a rigorous textual analysis as described in 3.2.1 Identification of Cross-Disciplinary Skills.



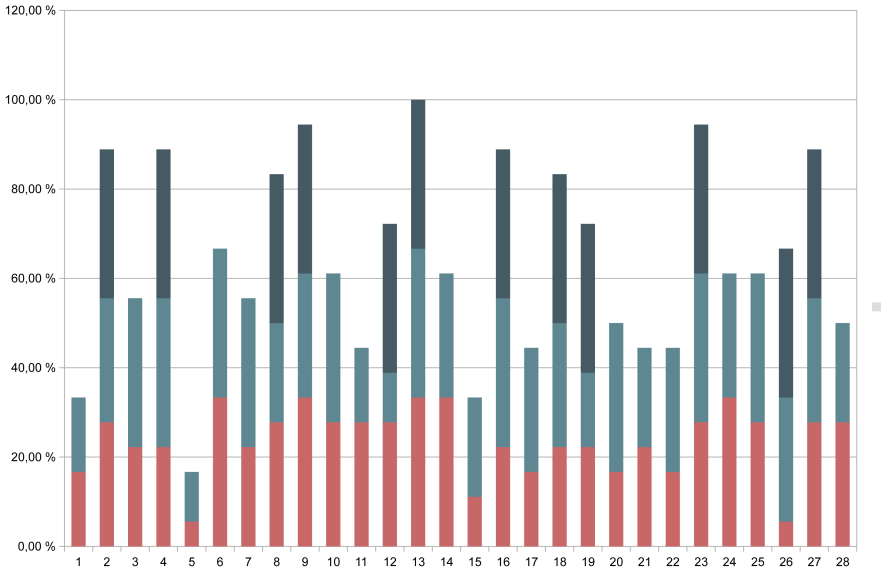
Graph 1: Assessing Variation in the Prioritization of a Repository of 12 Competencies Across 28 Pedagogical Case Studies

4.2 Unveiling the Most Effective Pedagogical Combinations

Our analysis also sought to identify the most *promising pedagogical combinations* that support a balanced development of the key *"Design Thinking traits"* (Graph 2 & Table 7):

- **University of Pretoria's Experience No. 13**: This approach, which ranks first in effectiveness, integrates *critical pedagogy***,** *live projects* (framed as experiential and social learning), and *transformative learning.* This combination fosters a comprehensive learning environment that promotes both social engagement and critical reflection. Critical pedagogy encourages students to question societal norms and power dynamics, while real-world projects immerse them in enhance practical and relational skills. Transformative learning deepens their values and perspectives, encouraging a commitment to sustainability and equity.

- **University of Montreal and University of Malaysia's Experiences No. 09 and No. 23**: Ranking second, these cases employ a *hybrid pedagogical approach*. Experience No. 09 from the University of Montreal combines *co-design, learning-by-doing*, and *design thinking*, creating an interactive framework that emphasizes practical engagement and collaborative creativity. Experience No. 23 from the University of Malaysia utilizes *student-centered learning, service learning, and project-oriented problem-based learning* (PoPBL), focusing on student autonomy and community-centred problem solving.



Graph 2: Representation of the "Design thinking Trait" Degree of Integration (in%) in the 28 International Cases Studies

Table 7: Degree of Integration of Design Thinking Traits in the 3 most Promising Pedagogical Experiences

Art /N°	Author(s)	Source	Year	Relevance to Design Thinking Traits		
				Collaboration	Empathy	Integrative Thinking
9	(Boudhraâ 2020)	PhD thesis University of Montreal	2020	33,33 %	33,33 %	27,78 %
13	(Breed et Mehrtens 2022)	***Land* journal's**	**2021**	33,33 %	33,33 %	33,33 %
23	(Wan Mohamad et al. 2012)	Malaysian Architectural Education Conference (MAEC 2012)	2012	27,78 %	33,33 %	33,33 %

4.3 Discussion and Implications of the Results

Although distinct in their implementation, the pedagogical experiences from Pretoria, Montreal, Malaysia, and many other cases converge around a common educational philosophy (Figure 2): experiential learning, a combination of pedagogical approaches, and "Design Thinking" as a mind set.

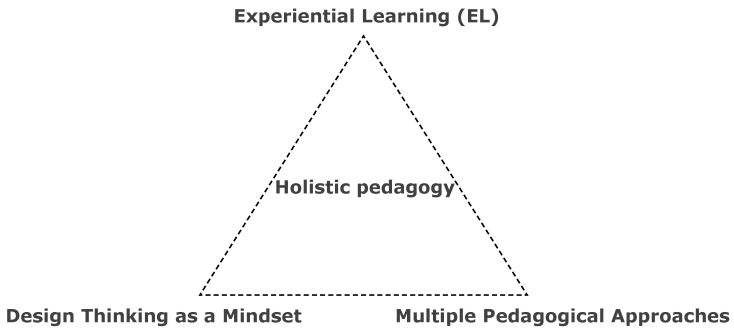


Figure 2: Framework of Holistic Pedagogy for Architectural Education

4.3.1 Experiential Learning: The Core of Studio-Based Pedagogy

The importance of "learning by doing" as a foundation of studio pedagogy is widely recognized, enabling students to apply theoretical knowledge to concrete projects and build a deeper understanding of real-world challenges. Christina Breed and Helge Mehrtens (2022) emphasize the transformative power of real-life projects for postgraduate design students, noting that:

> "*The real-world conditions of live projects foster experiential learning that could be deep and transformative.*"*(Breed et Mehrtens, 2022, p. 3)*

This approach aids students in adapting to dynamic urban environments while bridging the gap between theory and practice.

Students, having taken part in the study cases, frequently cited the "real-life nature" of projects as impacting their creativity by introducing actual constraints that required innovative responses. Furthermore, interdisciplinary and socially engaged components such as community feedback, on-site visits, and guidance from municipal representatives fostered rich, hands-on learning experiences (Breed & Mehrtens, 2022, p. 14). These real-world encounters, as Breed and Mehrtens note, helped students link their solutions more closely to community needs, illustrating how experiential learning cultivates empathy and integrative thinking by connecting students to the human context of their designs.

Blanckaert et al (2019) highlight collaborative learning as a key element of experiential learning, particularly in the context of real projects. Their research is based on the principle of "Design and Build", where students, working in groups, confront their ideas with the reality of the field. This process of co-design and co-creation encourages adaptation, exchange and discussion, leading to the appropriation of know-how. Emphasis is placed on the role of the "teacher" as a guide rather than a transmitter of knowledge.

Experiential learning (EL) is a dynamic process that engages learners in constant interaction with their social and physical environment, fostering a deep, embodied understanding of the world.

4.3.2 Design Thinking as a Mindset

"Design Thinking" is often misconceived as a simple, reproducible, problem-solving methodology. However, it is first and foremost a state of mind, a way of thinking and approaching problems. It is a complex (Ghonim, 2016; Avsec & Jagiełło-Kowalczyk, 2021), iterative process (Boudhraâ, 2020; Dorst & Cross, 2001) based on constant interaction between thought and action, enabling designers to refine their ideas and test them in real-life conditions. "Design Thinking" is more than the mechanical application of a series of predefined steps. It implies deep reflection, openness to experimentation and the ability to adapt to complex and changing situations.

4.3.3 A combination of Pedagogical Approaches

This distinction between mindset and methodology becomes particularly relevant when considering how "Design Thinking" is taught. The results of this study emphasize the limitations of a single, linear pedagogical approach, which, when focused solely on technical

and scientific aspects, reduces "Design Thinking" to a simplistic problem-solving tool. This reductive approach overlooks the human and social dimensions of design, thus hindering the development of essential cross-disciplinary skills like empathy and limiting the growth of interpersonal and social competencies. Todoroff et al. (2021) show that civil engineers, by focusing on specific technical objectives, often neglect the human and social dimensions of design, unlike architects who adopt a more holistic approach.

The University of Pretoria's approach illustrates the benefits of a pedagogical combination integrating critical pedagogy, real-life projects and transformative learning. Ranked among the most promising for the acquisition of "Design Thinking Traits", this approach promotes:

(a) **Deconstructing Norms and Power Structures:** Critical pedagogy encourage students to analyse existing systems, highlight embodied injustices and inequalities, and consider alternative solutions.
(b) **The development of Practical and Relational Skills:** Real-life projects confront students with the concrete challenges of the professional world, enabling them to apply theory to practice. They develop problem-solving, communication and collaboration skills, while understanding the constraints and opportunities of the real-life context.
(c) **Commitment to Deep Values**: Transformative learning aims for a profound shift in values and perspectives. By exposing students to social and environmental realities, it fosters a commitment to sustainability and equity.

5. Limitations of the Study

Publication Bias: The corpus studied could be biased by the tendency to privilege positive results, thus underestimating the challenges encountered in implementing pedagogical approaches.

Binary Scoring System: The use of a binary scoring system to assess empathy, while offering an initial comparative approach, fails to capture the subjective, relational and contextual nature of this trait. More refined and qualitative assessment (in-site qualitative observations) methods are essential to better understand the development of empathy in architecture students and the impact of pedagogical approaches on this development.

Lack of Longitudinal Analysis: The study does not assess the long-term effects (progress trough the five year curriculum) of pedagogical approaches on students' progression, due to the fact that this type of analysis was conducted in only a few of the studied cases.

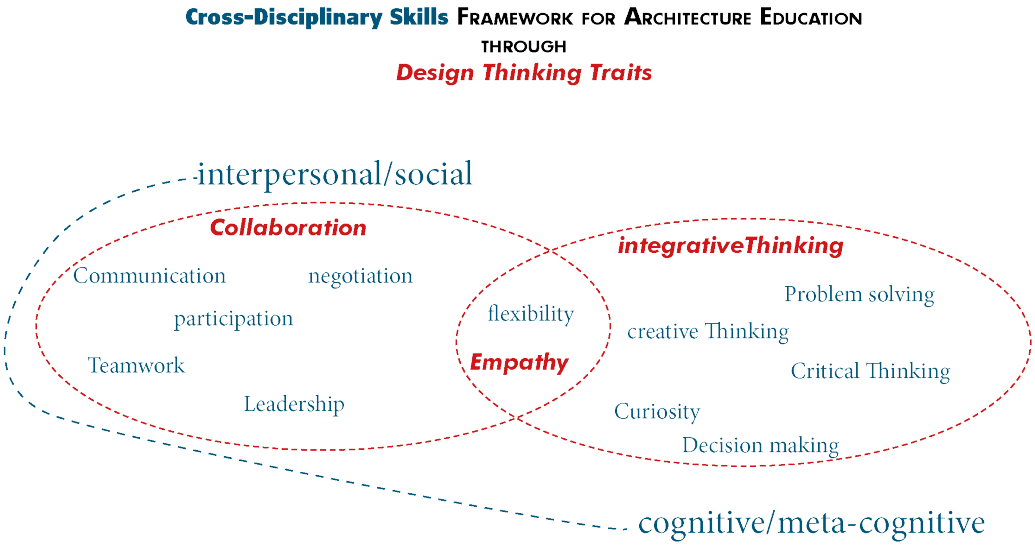


Figure 3: Empathy at the Heart of a Holistic Approach to Teaching Architecture

5. Conclusion and Recommendations

In this study we adopted a combined deductive and inductive approach to investigate the impact of pedagogical methods on the development of "Design Thinking Traits" in architectural education. Grounded in the theoretical framework of "Design Thinking Traits" (Brown, 2008; Blizzard et al., 2015), we analysed 28 international case studies to evaluate whether empirical observations aligned with this framework. Through a rigorous literature review and a textual analysis, we identified 14 new variations in the evolution of Project-Based Learning (PjBL) (Table 1) and 12 cross-disciplinary skills that are critical to the cultivation of these traits (Figure 3).

The findings highlighted the transformative potential of embodied experiential learning and hybrid pedagogical approaches in fostering a "Design Thinking" mindset. Certain pedagogical combinations—such as the South-African case study (N°13), which integrates critical pedagogy, real-life projects, and transformative learning—stood out as particularly effective in nurturing collaboration, empathy, and integrative thinking, essential competencies for 21st-century architectural education.

Studio-Based Pedagogy, at its core, bridges theory and practice through immersive, real-world projects. These experiences challenge students to navigate professional constraints and opportunities, honing both practical and interpersonal skills. By encouraging dynamic engagement with local communities, these projects foster empathy, collaboration, and integrative thinking, anchoring design processes in a richer, more human context.

Nevertheless, this study underscores the need to reconceptualize "Design Thinking" not as a rigid, linear methodology but as a flexible, reflective mindset. A purely technical or procedural interpretation risks reducing design thinking to a mechanistic tool, stripping it of its profound human and social dimensions. Instead, embracing a mindset rooted in critical reflection and adaptability—supported by hybrid and experiential pedagogies—can cultivate learning environments where students not only acquire skills but grow into empathetic, reflective, and innovative thinkers.

The holistic pedagogical framework proposed (illustrated in Figure 2) rests on three interconnected pillars: *Experiential Learning, Design Thinking as a mindset,* and *the integration of Diverse Pedagogical Approaches.* Together, these pillars enable the cultivation of empathy as a vital link between collaboration and integrative thinking, as well as between cognitive/meta-cognitive and interpersonal/social dimensions.

To prepare students for the multifaceted challenges of architectural practice, this study advocates for curriculum strategies that include:

- **Student-Cantered Learning:** Empowering students to take ownership of their learning process.
- **Combination of Diverse Complementary Pedagogical Approaches:** Integrating various methods to create resilient and dynamic learning ecosystems.
- **Horizontal Power Dynamics:** Encouraging educators to act as facilitators, fostering collaborative, cross-disciplinary, and participatory experiences.
- **Experiential Learning Opportunities:** Prioritizing "Design & Build" and "Live Projects" to ground education in tangible, real-world contexts.
- **Reflective and Critical Thinking:** Instilling a habit of self-assessment and fostering the ability to critically evaluate design processes through social, cultural, and ethical lenses, enabling students to become agents of meaningful societal change.

Architectural education transcends technical skill acquisition; it is a transformative journey that shapes students' world-views, values, and approaches to design. Drawing from the philosophies of John Dewey and Tim Ingold, this process of experiential learning becomes a holistic practice—engaging the whole individual and fostering a deeper understanding of self, society, and the environment.

In conclusion, "Design Thinking" lies at the heart of this educational transformation—not as a linear methodology but as an *embodied, intellectual practice.* It emerges through the interplay of body and mind, the engagement with social and physical contexts, and on-going reflection that enhances understanding of both self and society. By adopting this vision, architectural education can prepare students to design not just with skill, but with profound purpose and responsibility, empowering them to create meaningful, lasting impacts on the world.

6. Opening for Scientific Debate

During the BCE 2024, a rich discussion and a personal critical reflection on architectural education emerged around the themes of Experiential Learning, "Design Thinking" and pedagogical experiences. While this study provides valuable insights, it raises questions that deserve further exploration.

How can we design educational paths that promote a profound transformation of the individual, engaging them holistically (body, mind and emotions), and leading them to a heightened awareness of themselves, their values, and their role in society?

Given the integral role of empathy in socially responsible design, how can we measure empathy effectively in students and practitioners, especially considering its complex, multidimensional nature?

How can learning design support this transformative process by encouraging both introspection and concrete engagement with the real world?

How can "Design Thinking", as an embodied intellectual practice, help students translate their reflections into responsible actions and address contemporary challenges?

What is the role of educators in this process? How can we train and equip them to become mentors capable of guiding students in their personal exploration and the development of an ethical practice?

How can we foster the creation of a cross disciplinary community of learning within architecture schools, encouraging peer exchanges, collaborations, and collective knowledge building?

Finally, how can we evaluate the long-term impact of these pedagogical approaches on architects' professional practice and their social engagement? What research methods would allow us to measure the influence of these approaches on how architects tackle contemporary challenges and their societal responsibilities?

These questions underscore the importance of on-going research and collaboration in redefining architectural education to address the complexities of contemporary practice and societal needs.

7. Acknowledgments

An AI-assisted language editing tool was employed to improve the linguistic quality of this manuscript. The content and scientific accuracy remain the responsibility of the authors.

References

Abdelmonem, M. G. (2014). Transcending boundaries of creativity: Active learning in the design studio. *International Journal of Architectural Engineering Technology, 1*(1), 38-49. https://doi.org/10.15377/2409-9821.2014.01.01.5

Acuña, A., Maya, M., Britton, E., & García, M. (2017). Play lab: Creating social value through competency and challenge-based learning. In A. Berg, E. Bohemia, L. Buck, T. Gulden, A. Kovacevic, & N. Pavel (Eds.), *Proceedings of the 19th International Conference on Engineering and Product Design Education* (pp. 710-715). Oslo and Akershus University College of Applied Sciences. https://www.researchgate.net/publication/348362780_PLAY_LAB_CREATING_SOCIAL_VALUE_THROUGH_COMPETENCY_AND_CHALLENGE-BASED_LEARNING

Asefi, M., & Imani, E. (2018). Effects of active strategic teaching model (ASTM) in creative and critical thinking skills of architecture students. *International Journal of Architectural Research: ArchNet-IJAR, 12*(August), 209. https://doi.org/10.26687/archnet-ijar.v12i2.1340

Avsec, S., & Jagiełło-Kowalczyk, M. (2021). Investigating possibilities of developing self-directed learning in architecture students using design thinking. *Sustainability, 13*(8), 4369. https://doi.org/10.3390/su13084369

Aydemir, A. Z. (2017). Experiments, practices and positions in architectural design studio. *Thèse de doctorat, Université technique d'Istanbul*. https://www.academia.edu/42197073/Experiments_Practices_and_Positions_in_Architectural_Design_Studio

Blanckaert, S., Sterno, J.-M., Sire, O., & Possoz, J.-P. (2019). Apprendre la collaboration et apprendre par la collaboration dans un projet réel - à partir d'expériences en paysage et en architecture. https://hal.archives-ouvertes.fr/hal-02283995

Boudhraâ, S. (2020). L'approche codesign comme une stratégie d'apprentissage de la conception dans l'atelier de projet (Thèse de doctorat, Université de Montréal). Papyrus, dépôt institutionnel de l'Université de Montréal. http://hdl.handle.net/1866/24236

Breed, C., & Mehrtens, H. (2022). Using "live" public sector projects in design teaching to transform urban green infrastructure in South Africa. *Land, 11*(1), 45. https://doi.org/10.3390/land11010045

Bregger, Y. A. (2017). Integrating blended and problem-based learning into an architectural housing design studio: A case study. *Journal of Problem-Based Learning in Higher Education, 5*(1), 126-137. http://journals.aau.dk/index.php/pbl

Charalambous, N., & Christou, N. (2016). Re-adjusting the objectives of architectural education. *Procedia - Social and Behavioral Sciences, 2nd International Conference on Higher Education Advances, HEAd'16, 21-23 June 2016, Valencia, Spain, 228*(July), 375-382. https://doi.org/10.1016/j.sbspro.2016.07.056

Coleman, E. E. (2018). Comparisons of design thinking for engineering education. *Thèse de doctorat, Virginia Tech*. https://vtechworks.lib.vt.edu/handle/10919/85867

Delpire, D. (2019). Apprendre par le faire en étant utile à la société: Retour d'expérience sur l'atelier de projet "Architecture Construite". In *Questions de Pédagogies dans l'Enseignement Supérieur*. ENSTA Bretagne, IMT-A, UBO. https://hal.archives-ouvertes.fr/hal-02283989

Edlby, Y. (2016). Improving creative ability as the main focus to promote education in architectural design. *Edinburgh Architecture Research, 34*, 1-11. https://journals.ed.ac.uk/ear/article/view/9806

Freitas, A. P. N. de, & Almendra, R. A. (2021). What if...? Strategies to teaching communication, empathy and teamworking for design students by design students. In C. S. Shin, G. Di Bucchianico, S. Fukuda, Y.-G. Ghim, G. Montagna, & C. Carvalho (Eds.), *Advances in industrial design* (pp. 245-260). Springer International Publishing. https://doi.org/10.1007/978-3-030-80829-7_19

Ghonim, M. (2016). Design thinking in architecture education: Issues, limitations and suggestions. *ResearchGate*. https://www.researchgate.net/publication/321747584_Design_Thinking_in_Architecture_Education_Issues_Limitations_and_Suggestions

Holubchak, K. (2020). The application of design thinking methodology in architectural education in Ukraine: Case study. *Architecture, Civil Engineering, Environment, 13(4), 19-29. https://doi.org/10.21307/acee-2020-027*

Kamrowska-Załuska, D., & Parteka, T. (2020). Design thinking (DT) for the design and planning education of engineer-architects. Academia.edu. https://www.academia.edu/88124802/Design_thinking_DT_for_the_design_and_planning_education_of_engineer_architects

Khodeir, L. M., & Nessim, A. A. (2020). Changing skills for architecture students' employability: Analysis of job market versus architecture education in Egypt. *Ain Shams Engineering Journal, 11*(3), 811-821. https://doi.org/10.1016/j.asej.2019.11.006

Kimbell, L. (2011). Rethinking design thinking: Part I. *Design and Culture, 3*(3), 285-306. https://doi.org/10.2752/175470811X13071166525216

Kowaltowski, D. C. C. K., Bianchi, G., & Paiva, V. T. de. (2009). Methods that may stimulate creativity and their use in architectural design education. *International Journal of Technology and Design Education, 20*(4), 453-476. https://doi.org/10.1007/s10798-009-9102-z

Kurjenoja Lounassaari, A., Schumacher, M., Meza, E., & Gutierrez, E. (2019). Expansive learning and change laboratory model in architectural education: A Mexican approach. Academia.edu. https://www.academia.edu/39758847/Expansive_Learning_and_Change_Laboratory_Model_in_Architectural_Education_A_Mexican_Approach

Lawson, B. (2005). *How designers think: The design process demystified* (4e éd.). Architectural Press.

McDonagh, D. (2010). Rethinking design thinking: Empathy supporting innovation. *Academia.edu*. https://www.academia.edu/2954501/Rethinking_Design_Thinking_Empathy_Supporting_Innovation

Nyka, L., Cudzik, J., & Szakajło, K. (2020). The CDIO model in architectural education and research by design. *World Transactions on Engineering and Technology Education, 18*, 85-90. https://www.researchgate.net/publication/341453328_The_CDIO_model_in_architectural_education_and_research_by_design

Ramadan, K. (2012). Introducing evidence-based design to architectural education: Bridging the gap between research and practice. *Universiti Putra Malaysia,92-102.* http://irep.iium.edu.my/28611/3/MAEC_2012_Proceedings.pdf

Salam, H. (2012). International urban design workshop as a base for reflexive development. *Universiti Putra Malaysia*. https://www.academia.edu/2315297/International_Urban_Design_Workshop_as_a_Base_for_Reflexive_Development

Salama, A. (2021). *Transformative pedagogy in architecture and urbanism*. Dans Routledge eBooks https://doi.org/10.4324/9781003140047

Salama, M., & Wilkinson, N. (2007). *Design studio pedagogy: Horizons for the future*. The Urban International Press. https://ashrafsalama.blogspot.com/2021/02/design-studio-pedagogy-horizons-for.html

Shareef, S., & Farivarsadri, G. (2020). An Innovative Framework for Teaching/Learning Technical Courses in Architectural Education. Sustainability, 12(22), 9514. https://doi.org/10.3390/su12229514

Tessier, V. (2021). Étude exploratoire sur le travail en équipe d'étudiants dans l'atelier de design: Vers un modèle d'évaluation pour l'apprentissage basé sur la théorie de l'activité et l'apprentissage expansif [Exploratory study on team collaboration of students in the design studio: Towards an evaluation model for learning based on activity theory and expansive learning]. Université de Montréal. https://hdl.handle.net/1866/25512

Todoroff, E., Shealy, T., Milovanovic, J., Godwin, A., & Paige, F. (2021). Comparing design thinking traits between national samples of civil engineering and architecture students. *Journal of Civil Engineering Education, 147*(2), 04020018. https://doi.org/10.1061/(ASCE)EI.2643-9115.0000037

Wan Mohamad, W. S., Ismail, I. S., Mohd Noor, M. Z., & Ismail, Z. (2012). Experiential learning: The Kuching project. *Faculty of Design and Architecture, Universiti Putra Malaysia*. https://www.academia.edu/3529642/Experiential_Learning_The_Kuching_Project

Wesołowski, P. (2022). Enhancing architectural engineering students' acquisition of artistic technical competences and soft skills. In N. Makhubu (Ed.), *Cogent Arts & Humanities, 9*(1), 2043997. https://doi.org/10.1080/23311983.2022.2043997

Contact email: ines.tlemsani@etu.univ-montp3.fr