Delft University of Technology

AR2A011 Architectural History Thesis

From Drafting Tables to Digital Screens

1980-present

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Project: Hand Drawing vs. Digital Design

Abstract:

This thesis examines how the transition from hand sketching to digital tools like CAD software and Adobe programs has affected the creativity of architecture students at TU Delft from the late 20th century to the present. Through the creation of a historical history of these tools, the research investigates their role in the conceptual design process as well as their impact on ideation and creative thinking. In order to comprehend how these tools have changed architectural education, it integrates teacher and student interviews, theoretical viewpoints on creativity, and an examination of instructional strategies. In order to foster creativity in architectural design, the ultimate objective is to acquire knowledge that will aid in finding a balance between conventional and digital approaches.

Content:

Introduction:

Digital tools have brought about a fundamental change in how architects are taught. Where students previously filled rolls of sketch paper with hand drawings, they now work predominantly with Computer-Aided Design (CAD) software and programs offered by Adobe. The process started in the1980s when CAD technology was introduced (Luo, 2024), and it grew and matured over the years. This raises the fundamental question: What has this transition meant for the development of creativity, in architecture students?

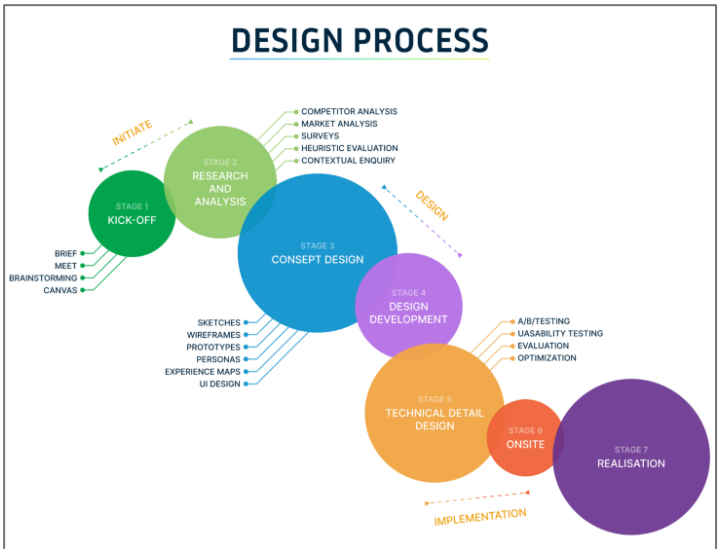

Figure 1: The Design Process, illustrating the conceptual design phase in relation to other stages of architectural development (LogRocket, 2023).

Creativity-8 Words(2014) states that creativity is intertwined with art ability, art expression, inventiveness, originalness, imagination, and creative ability. The builder focuses on the conceptual design phase, the critical early phase of an architectural project where ideas developed during schematic design are further developed, explored, and transformed into the first iterations of designs. The part of the design process that sinks between research and early ideation and thorough development and implementation is the conceptual design phase, as shown in Figure 1 (LogRocket, 2023). The acceptance of digital tools over hand drawing has had a significant impact on the creativity of students at TU Delft and we outline matters of the transition in this study.

The central research question of this study is:

"How has the evolution from hand drawing to digital drawing, specifically CAD software and Adobe tools, impacted architectural students' development of creativity at TU Delft from the late 20th century to the present?"

This question is answered through previous theories and a review of past work. For example, Amjed and Hawar (2015) claim that the traditional drawing significantly boosts imaginative ability, to which Pallasmaa (2011) agrees and states that the hand drawing enhances a more intimate and cognitive bond between the designer and the design. In contrast, Luo (2024) shows that CAD was implemented at TU Delft for efficiency first, and for creativity later. Moreover, according to Mohammedi and Arrouf (2024), CAD tools leveraged at initial design stages can reduce cognitive productivity as they tend to restrict flexibility and intuitive exploration.

This thesis consists of different chapters. It starts with a review of the historical evolution of design tools and then discusses the manifestation of these tools in the TU Delft curriculum. Section two examines: The impact of hand drawing and the digital tools on student creativity based on theoretical studies, interviews with faculty and a student survey. Finally, it gets to the findings where the recommendations are made to balance traditional and digital architectural education.

While some aspects of AI-driven and generative design tools are becoming more relevant, this study is restricted to tools where the designer still has direct control over the creative process. These emerging technologies are recognized, but are analogous to the scope of the analysis.

I. Methodology

This study, therefore, adds both a literature review and qualitative fieldwork explorations at TU Delft. Semi-structured interviews were conducted with a number of faculty members from various related departments, who were recruited based upon their knowledge of architectural education, pedagogy, or design theory. A survey sent to students helped gauge what the current generation is experiencing regarding hand drawing/digital tools in the conceptual design phase.

There are some methodological constraints. Note that interviewees and student respondents are a purposive sample, not statistically representative. Because their disciplinary and generational perspectives are specific, faculty members are named while the students remain anonymous. As this is a qualitative study, the results are interpretive and should not be extrapolated beyond the TU Delft context. However, triangulation of literature, interviews, and survey responses provides layered and grounded insights into how design tools shape students' creative development.

Historical Background: From Hand Drawing to Digital Tools in Architectural Education

Over the past few decades, the design tools utilized in architecture education have changed significantly, moving from manual drawing methods to computer-integrated programs like Adobe and CAD. The development of these tools and how they have influenced the use of architectural methods are examined in this chapter. To make links between these technologies and creativity, it is necessary to first look at how they have evolved historically. In the upcoming chapter, this relationship will be covered in more detail.

I. Development of tools

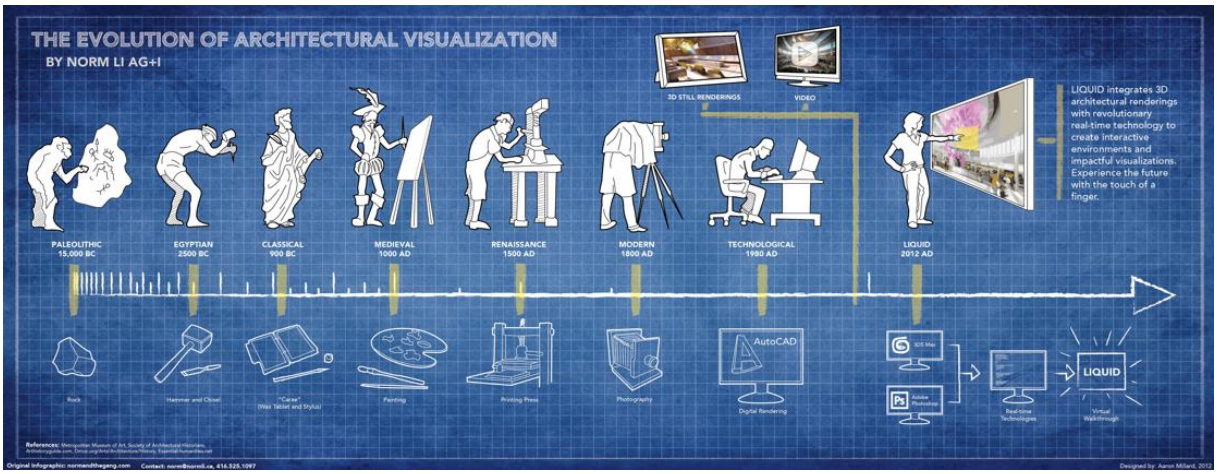

Figure 2: The Evolution of Architectural Visualization, highlighting key transitions from traditional to digital tools Source: Norm Li (2012), as cited in Markitektura (2014)

From the birth of hand-drawing techniques to advances in digital rendering methods, architects and architectural designers have all relied on some form of design tool, but the tools we use date back centuries, and the discipline of architectural design is increasingly evolving to embrace new tools. Architecture visualization has evolved over the years, as noted in the Figure 2, extending from ancient rock contours and carving on stones into the digital age with the help of 3D modeling and rendering technologies (Markitektura, 2014). This metamorphosis has changed the way architects visualize and articulate their thoughts. The next few sections highlight the key technological developments that have shaped architectural visualization.

Until now we used to hand-draw our ideas on the early design phase. Some used T-squares, drafting boards, compasses, and set squares, to create architectural drawings (Piedmont-Palladino, 2007) They used these tools, both for precision work and freehand design. As such, Matthewson (2018) argues, the methodology was for such a long time embedded deeply within architectural practice given the nature of traditional hand-

drawing techniques, which reinforced one's spatial reasoning, understanding of materiality and related the materials to an iterative process of design exploration.

In the mid-20th century, the architecture studio focused on ink-on-paper drafting techniques, and students spent years learning how to shade and visualize their drawings. While the basic process of drawing by hand was still a central component of its professional practice (Matthewson, 2018), architectural firms performed drawing on paper as blueprints and presentation drawings. But as the digital tools for drawing proliferated, the hand-drawing of the architect began to change.

CAD software was introduced in the late 20th century and this fundamentally changed architectural drafting. AutoCAD was released in 1982 (Piedmont-Palladino 2007), a milestone in architectural education and practice. With the arrival of CAD software, architects could create detailed digital drawings that were easily adjustable, a significant time saver in the drafting process. Professionals started to experiment with more sophisticated draughting methods in the 1980s, which led to the early adoption of CAD (Luo, 2024).

By the 1990s CAD had become a commonplace tool in architectural operations. This step was framed within a broader transition to the digital that Luo (2024) interprets as the initial integration of CAAD (Computer-Aided Architectural Design) software by industry professionals. Gradually, however, this period was defined more by an integration of hand-drawing as a necessary part of architectural design with digital tools.

The 2000s introduced parametric design, BIM (Building Information Modeling) and digital fabrication; advancements in design tools that marked yet another evolution. These were incorporated as integral parts of architectural workflows. Luo, (2024) with software like Revit, Rhino, and Grasshopper allowing architects to undertake complex computational design processes. Digital simulation tools and 3D modelling were a technological upgrade, at least to industry standards.

Some architects expressed worries about the declining emphasis on conceptual inquiry through hand-drawing, even as computer modelling increased efficiency and accuracy (Luo, 2024). These concerns continue to influence discussions on architectural methodology.

II. The incorporation of Tools in TU Delft's Curriculum

Luo (2024) shares a detailed account of TU Delft's initial attempts to integrate digital tools into its architectural education. The first computer laboratories were built in the late 1980s, giving students the opportunity to experiment with CAD software. In their early, experimental implementations, digital technologies were appended to the essential elements of the curriculum.

Around the 1990s, separate CAAD (computer-aided architectural design) courses were developed at TU Delft as part of the inclusion of digital workflows into the architecture curriculum. This period was the start of an evolution from analog drawing methods to digital ability, and CAD-based tasks were required from the students.

Significant curriculum changes were made at TU Delft in the early 2000s to bring it into line with developments in digital design. Luo (2024) claims that these reforms comprised: CAAD courses are required for the Bachelor's degree, greater focus on digital fabrication and 3D modelling and introduction of Python and Grasshopper, two scripting and parametric design tools.

These modifications were part of a larger movement in architectural education where students entering the field now need to be digitally literate (Van Dooren et al., 2013). The curriculum was adapted to balance technical skills and conceptual design thinking to make certain digital technologies supplement, rather than supplant, traditional architectural practices.

To this day, the curriculum TU Delft is updated to include the most innovative technologies such as generative design algorithms, virtual reality and artificial intelligence (Luo, 2024).

There are continuous discussions concerning the best way to strike a balance between computational efficiency and intuitive, hand-drawn conceptualization, making the role of digital tools in architectural education a dynamic and changing subject.

Despite the growing dominance of digital tools, hand drawing remains a central aspect of architectural practice and education at TU Delft. Professor Kees Kaan (interview), architect and studio instructor at TU Delft remembers that the time of AutoCAD in the late 1980s did not result in the abolition of sketching and hand drafting as an integral part of the process. To this day, he notes, students still employ hand drawing not for finished presentations, but as a fast, intuitive means of generating ideas and communicating them clearly in the early stages of a project.

Architect, former Dean of the Faculty of Architecture at TU Delft and professor Dick van Gameren (interview) endorses this perspective at a curricular level. In his perspective, hand drawing is alive and well at TU Delft's design studios, especially in exercises involving observation, site analysis, or concept development. Sketching is even a formal requirement in some courses, he notes. Van Gameren also underlines the continuing use of hand drawing, it is not only a didactic tool, part of a wider architectural culture formed in part by international diversity. For example, students from countries such as India tend to arrive with a more robust pedigree in freehand sketching.

These observations also point to the fact that while many aspects of architectural education have become enacted through digitalization, there are still practices such as drawing that have retained their roots, particularly in the early design phases where drawing stimulates intuitive thinking and reflective spatial exploration.

The above practices however indicates that hand drawing still holds a significant part in TU Delft education, but it is interesting to investigate if similar developments are happening in other architectural educational contexts worldwide

III. A Global View of Hand Drawing in Architectural Education

Although TU Delft's arc points toward digital tools, international comparisons reveal hand drawing as a mainstay of architectural training in many institutions.

One study was conducted at the Cracow University of Technology, where Makowska (2021) examined challenges and possibilities of online teaching of freehand drawing during the COVID-19 pandemic. Even in remote settings, she found, open-ended sketching tasks fostered students' independent thinking, creative exploration, and observational prowess. According to Makowska, "Sketching and ideation are not only tools of creativity and communication, but also a motivating factor in learning" (p. 44).

In his previous paper, Makowska (2015) built on this topic stating that besides communication of design; hand drawing supports spatial intelligence and imagination development. As she cautioned the preoccupations with digital tools have the potential to incur the loss of "personal expression and conceptual clarity" (p. 46), particularly, under exclusively screen-based workflows adopted by the students. The paper also notes that architectural employers have had significant concerns over the diminishing drawing judgments of graduates relating to professional expectations.

These external perspectives also bolster the notion that hand drawing is still a powerful cognitive and creative tool to wield. Compared to TU Delft's digital integration, they show how sketching must remain foundational, not just in nostalgic terms.

IV. Conclusion

Since conventional hand-drawing to more recent widespread use of digital technologies, this chapter documented the historical evolution of the tools of the trade. TU Delft has pioneered the implementation of digitally informed techniques for architectural education, from the introduction of CAD in the early 1980s to today's elaborate parametric and BIM-driven pipelines. But, interviews and curricular examples show that hand drawing is still a key part of early design phases, especially when it comes to cultivating intuitive and spatial thought. International views also reinforce the maintenance of drawing as an important means for architecture educationε. For some, there must be a balance between technical detail and creative exploration or other intellectual paradigms, even if technology makes our tools more powerful and accurate. The subsequent chapter will dissect these questions.

The effect of tools on creativity: hand drawing vs. digital tools

Creativity is a must-have in the conceptual design phase of architecture. As concepts are formed, tested, and honed in this initial stage, understanding how different a broader range of instruments can yield creativity is critical. To this day, architectural workflows have transformed significantly due to the constant move from the traditional hand drawing practice to the usage of digital tools such as Adobe and Computer-Aided Design (CAD) software. Digital tools are efficient and precise, but their effects on creative inquiry and intuitive thinking have drawn criticism (Luo, 2024; Mohammedi & Arrouf, 2024). This chapter uses both theoretical understandings and real-world experiences from TU Delft instructors and students to examine how creativity is affected by hand drawing and digital tools.

I. The role of hand drawing in creativity

Hand drawing has long been a fundamental component of architectural education and is known to stimulate creativity. Pallasmaa notes how hand drawing represents a cognitive connection between the designer's mind and the act of design, thus improving spatial perception and intuitive problem-solving (Pallasmaa, 2011). Similarly, Amjed & Hawar (2015) found that traditional drawing tools significantly expand creative capacity, allowing for free exploration and flexible development of ideas. For their research, one group of students had to develop digital tools to produce architectural concepts, while another group did it by hand. The results revealed that even though the students whose solutions involved more digital tools tended to be more organized, the students who sketched by hand produced fewer ideas, but much more creative and varied. Yıldızoğlu (2024) supports this, claiming that freehand sketching promotes adaptable thinking in the early stages of design, which is essential for creative problem-solving.

Faculty and student perspectives from TU Delft support these theoretical assertions. According to Peter Koorstra former Form studies lecturer and architectural design tutor, TU Delft (interview), hand drawing is absolutely essential for concept development since it enables architects to more naturally find new design opportunities and spatial relationships. Koorstra's observations support Pallasmaa's (2011) thesis that hand drawing helps the designer to develop a closer cognitive connection with the design process, so enabling a more intuitive and spatially aware exploration of ideas.

Students who rely mostly on digital tools often suffer with scale and spatial perception, he noted. He said, physical models also help this process by giving a concrete way to assess spatial feasibility early on. Because it allows for experimentation without the limitations of digital interfaces, many respondents said that hand drawing is their preferred method during the conceptual phase. *"Sketching on paper gives me freedom*

and allows me to make mistakes, whereas digital tools often feel restrictive." Another noted: *"I start with hand sketches to quickly explore concepts before moving into digital tools for refinement."*

These answers imply that manual drawing is still crucial for encouraging creativity even in the face of the increasing use of digital tools.

II. The influence of digital tools on architectural creativity

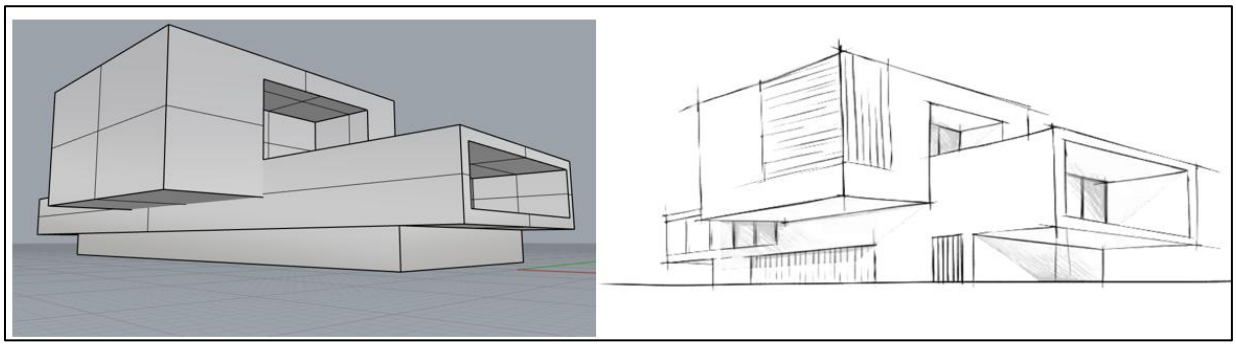

Figure 3: Comparison between a digitally modeled volume study (left) and a freehand sketch (right), illustrating differences in structure and creative flexibility. (Own work)

I figure 3 you see the comparison between digital modeling and free hand sketching. Because they offer precise modelling ability and efficient workflow management, digital technologies have changed the nature of architectural education and the profession at large. However, research suggests that these tools were designed with efficiency in mind instead of creativity (Luo, 2024).

While institutions discuss how to address the adoption of digital tools, students for their part are already pragmatically resorting to new technologies without reflecting on the underlying implications for creativity, authorship or design values, Georg Vrachliotis, dean of the Faculty of Architecture and the Built Environment, TU Delft, (interview) pointed out. This forms a conflict between institutional pursuits and the pragmatic, outcome-oriented actions of students.

While digital technologies provide advanced modelling and iterations, according to Yıldızoğlu (2024), they impose a pre-structured design process, blandness for unplanned creative discovery. Furthermore, CAD software may induce inflexible workflows where designers prioritize technical execution over creative exploration (Mohammedi & Arrouf, 2024). Additionally, Amjed & Hawar (2015) stated that if students begin a project with digital tools, they are more likely to present traditional and structured ideas, whilst those students that begin with freehand drawing create more diverse and creative proposals.

Additional insights from faculty interviews at TU Delft on how creativity is impacted by digital tools. The pressure for students to follow a set workflow is, after all, part of the nature of digital tools, as Mieke Vink Form Studies Lecturer in architecture, TU Delft

(interview) notes, and forces the belief that other ways are impractical. Meike said when using a method good, with the right techniques (digital or by hand), you can always be creative. Students now switch to digital tools sooner than they did a few years ago, she said, and that compresses the exploratory phase. Earlier renditions of students would fill entire paragraphs in sketch rolls with exploratory drawings, which contributed to an iterative design process. Also, Vink explained that although digital tools are effective, they might tacitly encourage students to new-age hack towards the 'right' answer since the software boundary conditions affect the outcome of the design.

Building on this viewpoint, Peter Koorstra (interview) argues that instead of completely replacing hand drawing, the right digital tools should be introduced at the right time. He said one such group of students has learned so much to depend on digital tools since the design process began that their ability to intuitively engage spatial relationships is suffering. Early-stage sketching and spatial experimentation should not be supplanted by digital tools, which drivers should only be used for polishing designs and working with precision, he stressed.

Furthermore, Koorstra noted that the designer's awareness of scale and proportion is limited by digital tools. Although zooming in and out is possible with digital software, it does not offer the same spatial awareness as physically sketching or building a model. Architects can assess how a design is viewed at various scales: 1 meter, 10 meters, and 100 meters, in physical drawings or models, but students frequently find it difficult to decide which details should be highlighted at each scale in digital workflows when working digital.

Aart Oxenaar, former director of the Amsterdam Academy of Architecture, currently architectural historian, also noticed something similar when he looked back upon his Academy years at the Academie van Bouwkunst. He said that when the digital tools were first introduced, the faculty and students were impressed by the presentations because, first of all, they were visually striking. But he stressed the fact that early digital designs were generally crude and sober. First and foremost, the limitations of digital drawing systems ,that is to say, the most notable ones were being gradually outweighed as more sophisticated systems became eminent, showing how some initial setbacks can somehow be offset by the advent of technology.

Kees Kaan (interview), insisted that even with the advent of digital tools, hand drawing remains a natural part of the architectural design process. In his teaching experience, he notices that students love to use hand drawing as a quick intuitive tool for idea generation, most commonly in the early phase of concept evolution. He sees sketching as device that will never be outdone by digital designs, but in fact will enhance them. Even in complicated projects, hand drawing is still essential to honed design intentions and clear, iterative communication of ideas.

Dick van Gameren (interview) , helps explain that the fundamentals in hand drawing are intact to this day, for example, in studio courses involving observation, site analysis, or early conceptual development sketching in some circumstances an explicit

requirement. Van Gameren added that students from countries like India, for example, arrive in the studio with their freehand drawing skills well developed, indicating how the cultural and international differences in architectural education are reflected in how work is formulated. To him, these lessons are reminders that hand drawing is not a nostalgic exercise but rather also an important device for fostering spatial thinking and imaginative investigation during the earliest stages of design.

Respondents (students) noted that digital work flows can be constraining in the early conceptual phase of project building, but that many students acknowledge the benefits of digital tools to aid in completing and refining ideas. One student remarked: *"Rhino helps me visualize mass studies, but I sometimes feel limited by the software's predefined structure."* Another student noted: *"Digital tools are great for refining and presenting ideas, but they don't allow the same freedom as sketching."*

These findings suggest that while digital tools are important in modern architectural education, their premature adoption and overuse might hinder the stage of conceptual development

III. Finding a balance between hand drawing and digital tools

Many scholars argue that a blended approach leveraging both the strengths of hand drawing and digital technologies is the answer. Integrating traditional with digital methods enables students to take advantage simultaneously both for accurate modelling and intuitive sketching (Van Dooren et al., 2013). This balance ensures that students develop a range of skills and that efficiency is not put ahead of creativity. Yıldızoğlu (2024) also supports the view that combining the quick flexibility of hand drawing in initial design phases with the refining power of digital tools leads to more creative outcomes.

According to Mohammedi & Arrouf (2024), the intermingling of the two methods stimulates novel thinking and protects against cognitive inflexibility. for example, Luo (2024) notes how TU Delft's evolving curriculum continue to emphasize the value of retaining even basic sketching skills alongside digital proficiency. Students that use both various approaches tend to provide more holistic design approaches as they can explore ideation without any bounds before refining them (Amjed & Hawar, 2015). Their study found that utilizing CAD tools to refine initial ideation through hand drawing was associated with more fluid design processes and fewer regrets related to decision making. This approach combines freehand drawing (for initial concept generation) with digital tools (for fine details) to enable a more dynamic and iterative design process.

At TU Delft, faculty and students alike emphasize the importance of a balanced approach. Peter Koorstra (interview) tells us that students who incorporate both digital and hand drawing tools often end up with stronger design solutions as they are free to express ideas before refining them in a digital format He emphasised that students can fully interact with the spatial aspects of their designs before being limited by software constraints when they follow a step-by-step process that begins with freehand sketching and progresses to digital environments.

He emphasized that neither method should be seen as superior to the other; instead, they serve different purposes within the design process. According to Koorstra, students who work primarily with digital tools often struggle to recognize which details should be emphasized at different scales, an issue that becomes apparent when transitioning between concept sketches and final technical drawings. According to him, hand drawing enables designers to interact with these scale relationships more organically, a skill that has diminished with the rise of digital tools.

Likewise, Mieke Vink (interview) emphasised the value of preserving hand-drawing abilities, especially during the early stages of design. According to her, a lot of today's students are accustomed to using digital tools right away, which can lead to strict design methodologies devoid of iterative investigation. She also pointed out that students from other colleges where hand drawing still constitutes a significant portion of their curriculum possess better visual communication skills than from the TU Delft, and that visual communication skills are critical in both professional and academic architectural practice.

Similarly, Vrachliotis cautioned that constant dependence on digital environments can diminish students' spatial awareness, since they get used to zooming in and out without having a tactile experience of scale. He emphasized the value of exercises that help students reconnect to spatial thinking, and reiterated that hand drawing remains an indispensable part of the conceptual stage.

Preliminary survey results indicate that many students begin their architectural design process with quick hand drawings, only later moving to digital tools. As one student said: *"Hand drawing helps me come up with ideas, and digital tools help me shape and polish them."* One of the students at the school added: *"Hand sketching gives me a lot of freedom, but I am sometimes not sure how realistic my design is and how I can do it in real life, and at that point in the process I need some digital tools to be able to know it. I wouldn't want to work without either one."* This resonates with the work of Luo (2024), who demonstrates how the TU Delft curriculum, whilst evolving, retains an acknowledgement of the importance of preserving core sketching skills alongside digital proficiency. This approach underlies why a hybrid approach is needed and can only bridge creativity with technical accuracy within architectural education; for the benefit of all stakeholders.

IV. Conclusion

Using both theoretical understandings and real-world experiences from TU Delft, this chapter has investigated how architectural creativity is affected by hand drawing and digital tools. The results indicate that:

1. In the conceptual design stage, hand drawing is still essential since it promotes imagination, adaptability, and spatial awareness.
2. Although they are accurate and efficient, digital instruments can occasionally restrict creative expression.

3 The best strategy to encourage creativity in architecture education is to use a hybrid approach that combines the best features of both approaches.

So faculty are noting how an over-reliance on digital does risk an architectural loss of a sense of place and a loss of conceptual freedom particularly as you go down generations of architects and across where you teach. The shift towards efficiency through digital tools must no lose sight of the intuition and iteration inherent in sketching.

Achieves a balance between tradition and innovation that at a technical level is a sound compromise but is above all a pedagogic and cultural necessity of architectural education.

Discussion and analysis

This chapter analyzes the results of the literature review, interviews, and survey, while reflecting on how these results answer the central research question for this thesis: How does the evolution from hand drawing to digital drawing, particularly with CAD software and Adobe tools, impact architectural students at TU Delft and their development of creativity from the late 20th century to the present?

Numerous pieces of literature highlight the importance of hand drawing in terms of encouraging creativity in the conceptual stage. While scholars (Pallasmaa, 2011) point out the cognitive link that hand drawing creates, others (Yıldızoğlu, 2024) emphasize the freedom of design provided to designers at initial stages. Amjed & Hawar (2015)'s comparative study demonstrated that students working by hand produced fewer but more varied and creative solutions than those who worked digitally.

These theoretical insights resonate with the practices observed at TU Delft. The interviews with Peter Koorstra and Mieke Vink confirm that hand drawing is still essential in building spatial awareness and spatial exploration. But it's not without nuance. Architecture students are masters of craftsmanship, yet the decline in such manual skills is concerning; is it possible that an overemphasis on digital proficiency within the institution has deprioritized sketching skills?

However, the importance of digital tools is equally apparent. Moreover, CAD and Adobe tools are very efficient to enhance technical precision (Luo, 2024; Mohammedi & Arrouf, 2024). These tools have been integrated into TU Delft's curriculum, mirroring the demands of contemporary practice. The risk, however, lies in their early and exclusive use potentially constraining creativity during initial ideation.

A recurring theme from both reviews literature and TU Delft perspective is that of balance. Van Dooren et al. (2013) claim that integrating both methods prepares students with all-round skills. Interviews with Koorstra and Vink that support this, in which they emphasize that digital tools should empower not replace the conceptual conceptual freedom afforded by sketching. Responses to the survey also show that many students understand this need, that starting with sketches by hand and fine-tuning them digitally is the best way to iterate.

But there seems to be a gap between institutional emphasis and student practice. While the range of opinions about digital tools indicated that students valued hand drawing, students also expressed that they feel the pressure of being taught tools sooner than they might prefer, which may be indicative of larger expectations in postsecondary education and for their future professions. A number of students noted that while they appreciate the creativity that drawing by hand fosters, course expectations and presentation requirements cause them to make a move to digital work flows very early

in the semester. It raises the question of whether our teaching and learning structures really prepare a balanced skill set or merely drive a digital agenda at the cost of creative agility.

As described in the methodology, this study relied on interviews and surveys within the TU Delft context. While these offer deep insight into student and faculty perspectives, the findings are context-specific and may not be generalizable.

In all, the findings suggest that while digital tools can help students be more efficient, especially in design studios where simplified or overly structured digital environments dominate the workflow, the early and dominant use of these tools may limit students' ability to develop new ideas. To foster design creativity, a deliberate balance is essential, preserving hand drawing for early ideation, and applying digital tools for refinement and presentation.

Implications for Education

At the same time however, the results of this research also include crucial implications for the education of architects at TU Delft and abroad. This chapter considers ways in which the curriculum could be more conducive to creativity at a time of increasing digitalization among learners.

The strong benefit of hand drawing in supporting aspirational design implies that TU Delft's should reassert its value as an essential design skill throughout all phases of architectural education. This may involve:

- Requirement of freehand drawing class not only in 1st sem but inbuilt in the curriculum.
- Fostering iterative studio venues that necessitate interchangeable leveraging of sketching and digital media.
- Protecting faculty development instructors are prepared to lead students in interweaving both methods.

An incisive critique is also required of our curriculum, making certain that the assessment structures do not favour deliverables at the expense of early-phase creativity and conceptual development enabled through sketching.

Generational shifts toward early adoption of digital tools must be actively addressed. Emphasizing sketching across all phases not solely as a first-year endeavor might help reverse the trend. In addition, introducing assessment criteria that reward process and exploratory sketches, not just final digital products, would result in behavioral change among students.

Vrachliotis has noticed that in recent generations of students, concept exploration seems to take a back seat to perfectionism, visual presentation and slick digital deliverables. This change, he said, could be a function of shifting attitudes shaped by the prevalence of digital workflows.

These guidelines correspond to global trends that require greater adaptability and creative thinking. The need to ensure that students retain core design skills and cognitive flexibility, without becoming overdependent on software-driven routines, is even more critical as new technologies like AI and generative design tools get layered into the design process.

In conclusion, with an eye towards future developments in education, Vrachliotis stated that AI and other emergent digital technologies need to be integrated in the beginning of architectural education. He advocates for collaborative learning environments where students and faculty evolve together in their technological understanding, ensuring that innovation serves creativity rather than limiting it.

Conclusion

This dissertation has investigated the effect of the transition from hand drawing to digital tools on the creative development of architecture students at TU Delft. Compared with digital design processes, the research shows that hand drawing continues to play an important role in the conceptual design phase , supporting creativity, fluency, and spatial reasoning. In contrast, digital tools provide accuracy and efficiency, but they can stymie intuitive exploration when introduced too soon or used in isolation.

We have approached the topic based on a mix of theoretical literature, qualitative interviews and a student survey, answering the central research question of how the evolution of drawing techniques, ranging from hand drawing to digital tools such as CAD software and Adobe programs, has affected the creative development of architectural students from TU Delft from the late 20th century to today.

The results show that moving from hand drawing to digital tools has both benefits and drawbacks. CAD software and Adobe tools greatly increased precision and efficiency, but early and dominant use of these tools during the conceptual design stage can limit creativity by constraining exploration and intuitive problem-solving. The study shows that hand drawing promotes better flexibility and spatial awareness required for students' intuitive development of problem solving, which is critical for their creative development. This suggests a hybrid architecture design process that makes use of both hand drawing and digital tools, depending on the stage of the design process, to best support architectural creativity. This research is a TU Delft-exclusive from CAD and adobe tools. Future research might include cross-institutional comparison, or impacts of emerging technology such as generative design tools and virtual reality on creativity.

Arguably one of the central tensions in architectural education today is our responsibility in advising students on how to balance potential allures of technophilia with more primal (and less exciting) stanards of essential design skills. As ever, the devil is in the details: do hand-sketched images deliver insight that digital renderings could obscure? And it is up to those institutions, like TU Delft, to take a hard look at if curricula actually supports creative explorations or an imbalance of digital output over process. But as tools evolve, education must evolve in ways that ensure students remain versatile, creative and with the capacity for spatial reasoning at all scales.

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