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Advancing Quality Education in Architecture: A Comparative Study on Traditional and Digital Learning Approaches

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ABSTRACT

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This study compares traditional and digital learning methods in developing design and visualization skills among fourth-year architecture students at a private higher education institution in Cebu City, Philippines. It focuses on four core competencies: accuracy, creativity, efficiency, and spatial understanding guided by Design Thinking, emphasizing empathy, ideation, and iterative problem-solving. The study explores how pedagogical strategies shape student outcomes. A quantitative comparative design was employed, involving 187 randomly selected students. Data were collected through a validated questionnaire and analyzed using descriptive

statistics and paired t-test. Results showed that digital methods significantly enhanced accuracy and efficiency, especially in tasks requiring precision and technical output. Traditional methods, meanwhile, better support creative thinking and conceptual planning. Students reported that a blended approach combining both methods offered the most balanced and effective learning experience. The study concludes that a flexible, student-centered blended learning model best supports skill development in architectural education. This approach not only improves learning outcomes but also advances Sustainable Development Goal 4 by promoting inclusive, quality, and future-ready education. Furthermore, it aligns with internationalization by fostering digital fluency and pedagogical adaptability across diverse learning environments. The findings underscore the value of integrating thoughtful pedagogy with technology to prepare architecture students for the evolving demands of global design practice.

INTRODUCTION

Architecture education plays a critical role in developing the talents and capabilities of future architects. Over time, teaching methods have evolved to include both traditional approaches and cutting-edge technological advancements (Dutt & Ansari, 2022). Historically, architecture students relied on hand drafting, physical modeling, and manual rendering to articulate and develop design ideas (Saleh & Ansari, 2019). These methods, deeply rooted in architectural practice, have been credited with nurturing spatial reasoning, creativity, and problem-solving skills.

With the advent of digital technologies, architectural education has increasingly incorporated Computer-Aided Design (CAD), 3D modeling, and digital visualization tools. These innovations have enhanced collaboration, streamlined prototyping, and improved design precision for both students and professionals (Mihaela & Armenciu, 2024). However, the adoption of digital tools raises concerns regarding the potential drawbacks, such as reduced engagement with tactile, hands-on methods and potential overreliance on software.

Despite the integration of digital technologies, it remains unclear which approach, traditional, digital, or hybrid, most effectively develops design and visualization skills among upper-year architecture students (Dziuban et al., 2018). This ambiguity has fueled ongoing debate among educators, practitioners, and students about optimal teaching strategies in architectural education (Dutt & Ansari, 2022).

Proponents of traditional methods argue that they foster a deeper understanding of design principles, encouraging students to explore zoning,

spatial organization, and architectural form. Yet, these methods are often time-consuming and less adaptable to rapid changes in practice. Conversely, digital tools are associated with increased productivity, flexibility, and the capacity to produce more detailed designs (Dizon et al., 2024).

While each pedagogical approach offers distinct advantages, a critical concern remains: how can students be effectively empowered to transfer the skills they acquire into architecture schools, professional practice, and lifelong learning (Saghafi, 2021)? Previous research has explored the advantages and limitations of traditional and digital methodologies in architectural education. However, most studies focus broadly on architectural education without examining how these approaches impact students at different academic stages (Kaba & Abdou, 2022).

A notable gap exists in understanding the factors influencing students during transitional phases of learning, particularly in their fourth year, a critical stage for developing advanced design skills (Sen et al., 2021; Yaseen & Hameed, 2019). At this stage, students engage with complex tasks requiring both technical rigor and creative problem-solving (Iyer, 2015). Determining which learning methods best support students' growth during this pivotal phase is therefore essential.

Despite the increasing adoption of digital tools in architectural practice, many instructors continue to emphasize traditional methods, arguing that they cultivate foundational design skills not easily replicated through digital means alone (Bendre & Holey, 2022). This divergence in perspective raises an important research question: should fourth-year architecture students rely primarily on traditional methods, digital tools, or a combination of both (Pektas & Gurel, 2014)? Understanding how these approaches shape students' learning experiences is vital for refining curriculum design and instructional strategies, particularly for students bridging foundational knowledge with advanced architectural concepts (Rodriguez et al., 2018).

In response to these considerations, this study examines the effects of traditional and digital learning techniques on fourth-year BS Architecture students enrolled in a private higher education institution in Cebu, Central Visayas, Philippines. Specifically, it investigates which method more effectively enhances students' design and visualization skills, defined as the ability to conceptualize, represent, and communicate architectural ideas through manual techniques (e.g., sketching, physical modeling) and digital tools (e.g., CAD, 3D rendering). The findings aim to provide valuable insights for students, educators, and curriculum designers, supporting the development of effective hybrid learning systems that integrate traditional and digital approaches. Ultimately, this study seeks to compare the effectiveness of these methods in enhancing fourth-year architecture students' design and visualization skills and provide evidence-

based recommendations for improving architectural pedagogy.

OBJECTIVES OF THE STUDY

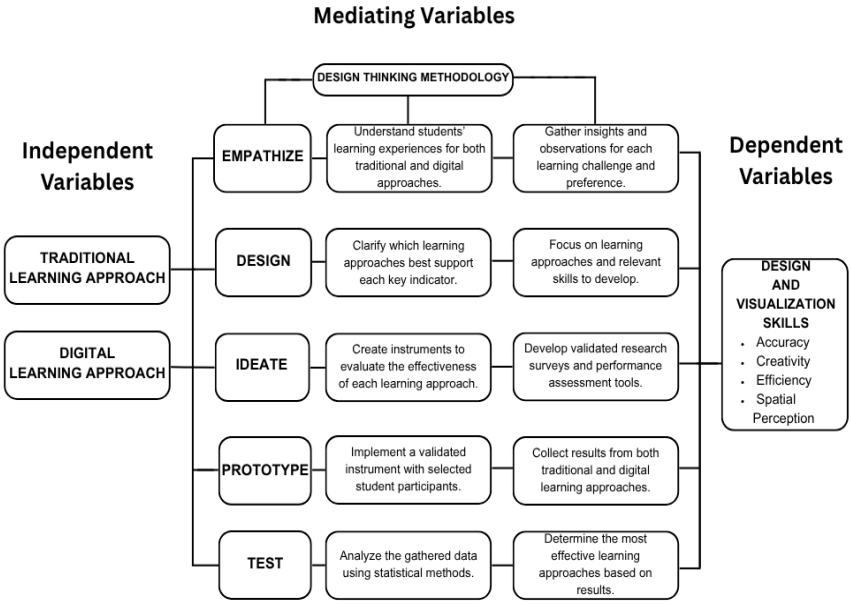
The study aims to compare and analyze the effectiveness of traditional drawing instruction and computer-aided learning approaches in enhancing the design and visualization competencies of fourth-year BS Architecture students. Specifically, it investigates how each method influences students' accuracy, creativity, efficiency, and spatial perception - competencies essential to professional architectural practice and increasingly shaped by ongoing technological developments.

For this purpose, the study seeks to:

1. Determine the effects of traditional drawing methods and CAD tools on students' accuracy, creativity, efficiency, and spatial perception in architectural design tasks.
   a. Assess students' perceived accuracy of architectural outputs produced using CAD tools in comparison with those created through traditional drawing methods.
   b. Examine the impact of CAD software and manual drawing on students' creative thinking processes.
   c. Evaluate students' perceived efficiency of workflow when using digital learning methods versus manual techniques.
   d. Analyze students' perceptions of how each method contributes to spatial perception, particularly in understanding scale and form.
2. Identify the strengths and limitations of traditional and digital approaches in the teaching of architectural visualization skills.
3. Examine students' perceptions of engagement, skill acquisition, and overall learning effectiveness when using traditional versus digital learning methods.
4. Compare the design outcomes of students using CAD tools and those employing manual drawing methods based on combined evaluation metrics.
5. Propose blended instructional strategies that effectively support the development of architectural design and visualization skills among fourth-year BS Architecture students.

The figure below represents the conceptual framework of the study, showing the application of the Design Thinking Methodology:

Figure 1
Conceptual Framework for Evaluating Traditional and Digital Study Approaches Using the Design Thinking Methodology



The traditional and digital learning approaches played a crucial role in shaping how fourth-year BS Architecture students developed their design and visualization skills. The traditional approach, characterized by manual drafting, sketching, and physical model-making supplemented by face-to-face lectures and studio critiques, allowed students to directly interact with materials and engage in hands-on processes that strengthened foundational design principles.

In contrast, the digital learning approach, which involved the use of Computer-Aided Design (CAD) software, 3D modeling applications, and digital rendering platforms, enhanced students' creativity, precision, and operational efficiency while exposing them to advanced industry technologies. Although each approach presented distinct advantages and limitations, both contributed significantly to students' acquisition of core competencies, particularly accuracy, creativity, efficiency, and spatial perception. These competencies, central to architectural education, served as the dependent variables through which the influence of the two learning approaches was evaluated.

The conceptual framework of the study was anchored on the Design Thinking Methodology, which provided a structured and user-centered foundation for

assessing the effectiveness of traditional and digital instructional modalities. Through its five interconnected stages - Empathize, Define, Ideate, Prototype, and Test, the methodology offered a systematic lens for linking pedagogical strategies to student outcomes. The Empathize stage enabled an understanding of students' learning experiences through a researcher-developed survey; the Define stage clarified the core problem by identifying which learning approach better supported specific competencies; the Ideate stage facilitated the development and refinement of performance criteria and instruments with expert input; the Prototype stage operationalized the research instruments to capture preliminary insights; and the Test stage applied statistical tools such as descriptive statistics, t-test, and correlation to compare the perceptions of both learning approaches.

These stages collectively structured the relationship between the independent variables (traditional and digital learning approaches) and the dependent variables (design and visualization competencies), thereby strengthening the study's analytical coherence. Overall, this conceptual framing established a clear pathway for examining how different instructional modalities influence architectural skill development. By situating the study within the Design Thinking Methodology, the framework not only demonstrated the iterative and experiential nature of design education but also highlighted the pedagogical mechanisms through which learning approaches shape student performance. This alignment provided a solid foundation for interpreting the findings and for identifying instructional strategies that most effectively support the development of essential competencies among fourth-year BS Architecture students.

METHODOLOGY

Research Design

This study employed a quantitative, comparative research design to evaluate the effectiveness of traditional and digital learning techniques in enhancing the design and visualization skills of fourth-year BS Architecture students from a private higher education institution in Cebu City, Philippines. The study was guided by the Design Thinking Methodology, which provided a structured and user-centered framework for linking instructional approaches to student outcomes.

Research Site

The institution was selected due to its strong integration of both manual and computer-aided design practices, making it an ideal setting for comparative analysis. The research focused on fourth-year students who had substantial

experience with both traditional and digital design methods, ensuring their suitability as participants for assessing the impact of different instructional approaches on the development of core architectural competencies (Johnson & Christensen, 2020; Cohen et al., 2017). The curriculum of the institution includes studio-based design classes, computer-aided design laboratories, manual drafting courses, and technical visualization subjects, where students are trained in both hand-drawing techniques and digital tools such as AutoCAD, Enscape, Lumion, Photoshop, Revit, and SketchUp. The program emphasizes individual and collaborative work, allowing students to engage with multiple learning formats, including traditional, digital, and blended approaches. This combination of curriculum and facilities provided students with substantial exposure to both learning methods, making their experiences suitable for comparative analysis.

Participants/Respondents

The study population consisted of 334 fourth-year BS Architecture students enrolled during the 2024–2025 academic year. Using simple random sampling, 187 students were selected as study participants, ensuring that each student had an equal chance of selection and that the sample was representative of the population. Simple random sampling was preferred over purposive or other non-probability techniques to reduce selection bias and enhance the generalizability of findings. All participants had prior exposure to both traditional and digital design methods, which was essential for comparing the effectiveness of these approaches in developing design and visualization skills.

Instrumentation

A researcher-made questionnaire served as the primary instrument for data collection. This instrument was designed to assess students' perceived effectiveness of traditional and digital learning methods in terms of creativity, spatial perception, task efficiency, and technical accuracy. Respondents rated statements using a 5-point Likert scale, enabling the quantification of subjective perceptions for statistical analysis (Boone & Boone, 2012). The questionnaire consisted of five sections: Section 1, collected demographic data; Section 2, assessed the frequency of traditional and digital method usage; Section 3, evaluated the perceived effectiveness of each approach in developing core competencies; Section 4, examined self-reported learning outcomes and application of knowledge; and Section 5, captured students' study method preferences to provide additional context.

The questionnaire underwent a rigorous development process to ensure validity and reliability. Items were generated based on a review of relevant

literature in architectural education and instructional methods. An expert in educational research reviewed the draft instrument for content relevance and precision. A pilot test was conducted among 15 fourth-year students not included in the final sample to identify areas for clarity and comprehension. Following revisions, reliability analysis produced a Cronbach's alpha of 0.83, indicating high internal consistency and suitability for the study. To further evaluate the reliability of the questionnaire, corrected item–total correlations were calculated for each item. All items demonstrated values above the recommended threshold of 0.30, indicating that each item contributed meaningfully to the construct it measured. No items were removed, confirming that the instrument maintained high internal consistency and item coherence across all sections.

Surveys have been shown to be appropriate in architecture education for evaluating subjective learning outcomes, self-perceived design development, and visualization skills. As Tovey (2016) highlighted, self-reporting tools such as surveys are widely used in design education to assess how students perceive their learning processes, particularly in areas influenced by visual-spatial interactions. Creswell (2009) further emphasized the relevance of surveys in educational research, noting their effectiveness for measuring beliefs, attitudes, and self-reported behaviors. Additionally, standardized survey instruments are crucial for ensuring reliable and comparable data collection across a target population. Given these considerations, the use of a survey questionnaire is an efficient method for gathering data from a large sample within a limited timeframe, making it an appropriate tool for comparing perceived learning effectiveness across traditional and digital study methods in architecture education.

Data Collection and Data Analysis

Data collection followed a triangulated approach, integrating performance tests, expert evaluations, and student self-assessments. This combination of objective measures, professional insights, and participant reflections strengthened the depth and reliability of the findings. Statistical analyses were performed using Microsoft Excel, including descriptive statistics (mean, median, mode, standard deviation, frequency distribution) to summarize survey responses, and inferential statistics (paired t-test) to evaluate differences between traditional and digital learning methods (Markulin et al., 2024). Correlation analyses further examined the relationship between students' preferred learning approaches and their perceived development of design and visualization skills (Royeras & Sumayo, 2024). These analyses enabled the identification of statistically significant differences and trends, providing a robust comparison of instructional effectiveness. Ethical considerations were strictly observed throughout the study.

Informed consent was obtained from all participants, who could withdraw at any time without penalty. Data were stored securely in Google Forms, and participants could optionally provide their names to maintain anonymity. Confidentiality was maintained, and all data collection and analysis procedures were conducted fairly and transparently to uphold research integrity.

RESULTS AND DISCUSSION

The survey findings from 187 fourth-year BS Architecture students at a private higher education institution in Cebu revealed students' perceptions of the effectiveness of traditional and digital learning methods, their reported learning outcomes, and their preferred approaches for developing design and visualization skills.

Table 1

Summary of Perceptions on the Effectiveness of Traditional and Digital Learning Approaches

Survey Item	Most Common Response	Frequency (n)	Key Insight	Supporting Literature
Sketching helped develop early design concepts.	Strongly Agree (42.8%)	80	Traditional sketching was highly valued for initial idea generation.	Gonçalves et al., (2014) ; Kim & Maher (2008) ; Tang et al. (2011)
Printed design materials support visualization learning.	Agree (41.7%)	78	Printed materials still played a decisive supporting role in visualization.	Moanis & Makram (2024) ; Wang & Ilhan (2009)
Computer-Aided Design (CAD) software helped develop architectural designs effectively.	Strongly Agree (67.4%)	126	Computer-Aided Design (CAD) tools were essential to effective design development.	Kalay (2004); Lee et al. (2020)

Online tutorials helped learn new design techniques.	Strongly Agree (70.6%)	132	Digital resources were highly effective in supporting design skill development.	Al-Samarraie & Saeed (2018); Davis (2024)
Digital visualization tools improved design presentation clarity.	Strongly Agree (72.2%)	135	Digital tools were perceived to enhance ideas' communication significantly.	Lee et al. (2020); Saghafi et al. (2014)
Digital modeling platforms helped explore design options effectively.	Agree (51.3%)	96	Most students found digital modeling functional in design exploration.	Lee et al. (2020) ; Saghafi et al. (2014); Wang et al. (2013)

In the Empathize stage, the data indicated that digital tools, such as Computer-Aided Design (CAD), 3D modeling, and digital visualization platforms, were highly valued by students. A majority reported that these tools improved the clarity, precision, and impact of presentations (72.2% strongly agreed) and supported skill acquisition through tutorials (70.6%). These findings align with previous studies, where digital platforms were linked to increased productivity, motivation, and technical proficiency (Wang, 2022; Kara, 2015). Conversely, nearly half of the students (42.8%) still considered freehand sketching useful during the early stages of design for concept exploration. Traditional drawing emphasized the role of paper as a medium that engages the designer in the act of thinking, allowing iterative drawing as a cognitive process. Such practices help externalize ideas, facilitate abstract reasoning, support memory retention, and demonstrate multiple forms of intelligence (Goldschmidt, 1994). Survey results further supported a blended approach, with 73.3% of students favoring the integration of both digital and traditional methods. Participants reported experiencing a tension between the precision and efficiency offered by digital tools and the creative and cognitive benefits associated with manual sketching. This perspective corroborates the concept of hybrid or blended learning, which has been suggested to optimally support all stages of the design thinking process.

Table 2

Summary of the Effectiveness of the Learning Approaches

Survey Item	Most Common Response	Frequency (n)	Key Insights	Supporting Literature
2D Computer-Aided Design (CAD) tools helped create accurate architectural drawings.	Strongly Agree (57.8%)	108	Digital drafting was strongly associated with high accuracy.	Fakhry et al. (2021); Team (2025)
3D modeling tools aid in visualizing complex structures.	Strongly Agree (70.6%)	132	Digital 3D modeling was vital for understanding complex spatial forms.	Darwish et al. (2023); Šafhalter et al. (2016)
Digital visualization tools communicate design intent effectively.	Strongly Agree (49.2%)	92	Visualization tools enhanced the clarity of presentations.	Villa & Zuccoli (2023); Yildirim & Yavuz (2012)
Blending traditional and digital methods fostered innovation and adaptability.	Agree (48.1%)	90	Combined learning approaches support flexible and innovative thinking.	Siddiquee et al. (2023); Kocaturk (2017)

In the Define stage, educational investment should focus on developing students' technical digital competencies alongside creative traditional skills to meet evolving learning demands. Digital literacy, including advanced Computer-Aided Design (CAD), 3D modeling, and visualization, was perceived as particularly valuable, enhancing efficiency, detailing, and presentation confidence, with 49.2% to 70.6% of students strongly agreeing with these benefits. At the same time, skills such as spatial understanding, visual memory, and constructive idea generation (48.1%) were primarily fostered through freehand sketching and manual modeling, as observed during the Empathize and Ideate stages (Yıldızoğlu, 2024). These findings underscore the importance of incorporating both traditional drawing and digital tools into all design studio courses to support comprehensive skill development. Furthermore, the development of meta-competencies, including tool-switching, critical reasoning, and iterative design reflection, was identified as essential. Such competencies support hybrid learning approaches that facilitate human–tool interaction across all stages of the design process, enabling students to maintain creativity while achieving technical

precision (Al-Rqaibat et al., 2025).

Table 3

Summary of Learning Outcomes and Application

Survey Item	Most Common Response	Frequency (n)	Key Insights	Supported Literature
Digital tools have improved performance in actual design projects.	Strongly Agree (51.3%)	96	Digital tools are linked to practical project success.	Ceylan et al. (2024); Al-Matarneh et al. (2016)
Digital modeling has improved spatial awareness.	Strongly Agree (44.9%)	84	Modeling software aids in understanding form and space.	Boumaraf & İnceoğlu (2020); Porat & Ceobanu (2024)
Used digital tools for finalizing technical drawings and presentations.	Strongly Agree (61.0%)	114	Students preferred digital tools for final output.	Fakhry et al. (2021); Yıldırım (2024)
Can effectively translate ideas using both traditional and digital platforms.	Agree (51.3%)	96	Students were confident using both approaches collaboratively.	Ismail et al. (2012); Kocaturk (2017)

In the Ideate stage, the survey instrument effectively captured students' perceptions of learning effectiveness. For instance, 72.2% of students strongly agreed that digital visualization enhanced the clarity and impact of presentations, while 70.6% strongly agreed that online tutorials supported skill acquisition. Additionally, 51.3% of participants agreed or strongly agreed that digital tools facilitated real design projects, and 44.9% reported improvements in spatial awareness. Students also expressed a strong preference for a blended approach, with 73.3% indicating that combining traditional and digital methods produced better learning outcomes. These quantitative metrics revealed clear differences in perceived effectiveness between digital, traditional, and hybrid approaches. The use of a robust 187 samples allowed for reliable statistical analysis, highlighting significant inclinations toward blended and digitally enhanced learning. These findings are consistent with prior studies, which suggest that integrating manual and digital tools supports both technical precision and creative development in architectural education.

Table 4

Summary of Learning Approaches Preferences

Survey Item	Most Common Response	Frequency (n)	Key Insights	Supporting Literature
Relied on digital tools for technical accuracy.	Strongly Agree (57.8%)	108	Students depended on digital tools for precision.	Ceylan et al. (2024); Saighi & Zerouala (2018)
Worked more efficiently using digital tools.	Strongly Agree (51.3%)	96	Efficiency is strongly associated with digital learning.	Saighi & Zerouala (2018); Sen Bayram et al. (2020)
More confident when presenting digitally rendered projects.	Strongly Agree (64.20%)	120	Digital presentation enhanced student confidence.	Kraus et al. (2022); Sediadi & Semlali (2022)
Preferred a blended learning approach.	Agree (48.1%)	90	Students valued the integration of both traditional and digital tools.	Araujo & Eiji (2024); Siddiquee et al. (2023)
Blended approaches provided comprehensive skill development.	Agree (52.4%)	98	Combined strategies were viewed as ideal for well-rounded design education.	Araujo & Eiji (2024); Peimani & Kamalipour (2022) ; Siddiquee et al. (2023)

During the Prototype phase, survey responses revealed a strong preference for a blended learning approach. Students valued the precision and confidence afforded by digital tools, with 51.3% strongly agreeing that this enhanced efficiency and 64.2% reporting increased confidence in digital presentations. Despite this, 42.8% continued to rely on freehand sketching, underscoring the enduring role of traditional methods in early ideation. Only 9.1% strongly agreed that traditional-only approaches fostered creativity, and 41.7% remained neutral - suggesting limited enthusiasm for purely manual techniques. A majority (73.3%) favored a hybrid model, aligning with literature that advocates combining analog and digital tools to balance creativity with technical precision (Al-Rqaibat et al., 2025). These insights informed the development of a prototype learning model

integrating both modalities to support comprehensive design skill development.

In the Test phase, this blended model was applied and evaluated. The results reinforced earlier preferences: students demonstrated improved performance, with 51.3% affirming greater efficiency and 64.2% expressing heightened confidence in digital presentations. The limited endorsement of traditional-only methods (9.1%) persisted, further highlighting their insufficiency when used in isolation. Continued support for hybrid approaches (73.3%) validated the prototype, reflecting the behavioral benefits of varied learning experiences. Students reported that combining manual and digital techniques enhanced technical accuracy while also stimulating creativity and adaptability—key attributes in iterative design processes. These findings affirm the value of blended learning as both a pedagogical strategy and a reflection of real-world design practice (van Passel & Beeloo, 2019).

Table 5

Paired t-test summary for Traditional vs Digital Methods

Variable Comparison	Mean Traditional	Mean Digital	t-value	df	p-value	Cohen's d
Traditional vs Digital	3.1824	3.3321	1.9728	186	0.0673	0.1443

To further support the descriptive Test phase results, a paired t-test was conducted comparing the perceived effectiveness of traditional vs digital design methods. The results indicate a non-significant difference between Traditional ($M = 3.18$) and Digital ($M = 3.33$) approaches, $t(186) = 1.9728$, $p = 0.0673$. The effect size, calculated as Cohen's $d = 0.1443$, indicates a very small difference between the two methods, suggesting that the practical difference between the two methods is minimal. These inferential findings align with the descriptive results, highlighting that students value both methods and support the use of a blended learning approach (Araujo & Eiji, 2024; Siddiquee et al., 2023).

Table 6

Pearson correlation between Traditional and Digital scores

Variable Comparison	Pearson r	p-value
Traditional vs Digital	-0.1381	0.0594

In addition, a Pearson correlation was calculated to examine the relationship between individual's respondents' ratings of traditional and digital methods. The correlation ($r = -0.1381$, $p > 0.05$) indicates a very weak and non-significant

relationship. This shows that individual perceptions of traditional methods do not meaningfully predict perceptions of digital methods, even though the overall mean ratings are similar.

Together, these findings indicate that, at the group level, traditional and digital methods are rated comparably, but at the individual level, respondents' perceptions of the two approaches are relatively independent. This highlights the importance of considering both approaches separately when designing instructional strategies, while still recognizing that both traditional and digital tools contribute meaningfully to learning and design development.

Transitioning into the Empathize and Ideate stages, the Design Thinking methodology enabled researchers to understand students' evolving learning needs. Digital drawing tools were perceived to enhance clarity, efficiency, and precision, while sketching remained essential for fostering creativity and spatial reasoning. This contrast underscored the need for a curriculum that integrates digital proficiency with traditional observational skills, promoting adaptability and iterative problem-solving. High response rates and strong agreement on the value of digital tools (72.2%) and blended approaches (73.3%) reinforced the validity of these insights.

These findings informed the development of a phase-specific educational model: sketching supported early conceptual exploration, digital tools facilitated refinement and presentation, and hybrid toolkits enabled continuous iteration. Testing confirmed students' preference for flexible, context-driven methods. This evidence-based curriculum shaped by empathy, ideation, prototyping, and testing demonstrates how Design Thinking can effectively align architectural education with the demands of professional practice. These findings illuminate the nuanced contributions of both traditional and digital methods to the development of core architectural competencies - accuracy, creativity, efficiency, and spatial perception. Students consistently expressed a preference for blended approaches, recognizing the precision and workflow advantages of digital tools alongside the cognitive and creative benefits of sketching. While traditional-only methods were viewed as limited in isolation, their thoughtful integration with digital platforms fostered a more holistic and adaptive learning experience. This convergence of modalities informed the design of a hybrid instructional model that not only responds to students' evolving needs but also mirrors the interdisciplinary demands of professional practice. Ultimately, the study affirms the value of Design Thinking as a pedagogical framework, one that bridges empathy, iteration, and evidence to shape responsive, future-ready architectural education.

CONCLUSION

The study revealed that both traditional and digital learning methods play essential and complementary roles in developing design and visualization skills among fourth-year BS Architecture students. Digital tools enhanced accuracy, efficiency, and presentation quality, while hand drawing and freehand sketching remained crucial for conceptual exploration, spatial understanding, and creative development. The results highlighted blended learning as the most effective strategy, integrating both approaches to support comprehensive skill acquisition. To prepare students for future professional challenges, architectural programs should combine future-focused digital tools with traditional, creative practices, delivered across online and offline platforms. Practitioners and policymakers are encouraged to invest in resources that support balanced development across these competencies. However, the study had several limitations. Data were collected from a single institution and relied primarily on self-reported survey responses and performance metrics, which may limit generalizability. The study focused specifically on design and visualization skills, excluding other domains such as structural engineering or project management. Students' prior experience, study habits, access to technology, and time constraints may have influenced outcomes. The use of questionnaires also introduced the risk of social desirability bias. Although the quantitative approach provided group-level insights, reliance on self-perception data may limit interpretations of individual skill development. Future research should address these limitations by expanding the sample, incorporating longitudinal and performance-based assessments, and exploring peer evaluations. Investigating which creative tools and teaching strategies most effectively support skill development could provide valuable guidance for curriculum design. Ultimately, the study affirms that integrating traditional and digital approaches is essential for cultivating well-rounded, competent, and future-ready architectural designers.

TRANSLATIONAL RESEARCH

This translational research takes the insights from architecture students' learning experiences and turns them into practical guidance for improving architectural education. By comparing traditional hand-drawing techniques with digital design tools, the study shows how each approach supports different skills - digital methods enhance accuracy and efficiency, while traditional methods nurture creativity and spatial understanding. Translating these findings into practice, it recommends a student-centered blended learning model that

combines the strengths of both approaches, offering a balanced way to develop technical precision and creative thinking. This model can be applied directly in classrooms, studios, and curriculum design, helping educators create learning environments that prepare students for the demands of modern architectural practice. Beyond improving skill development, the approach supports inclusive, quality, and future-ready education aligned with SDG 4, fostering digital fluency while maintaining the essential human touch of creative exploration.

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