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Integrating AI-generated client simulations in architectural education

Abstrak

Penelitian ini menguji integrasi simulasi klien berbasis AI untuk menjawab celah kritis dalam pendidikan arsitektur: keterbatasan paparan terhadap dinamika klien yang tak terduga dan berpusat pada manusia dalam pedagogi studio tradisional. Dilaksanakan di Studio Desain Terpadu, Universitas Islam Indonesia, riset memanfaatkan ChatGPT untuk menghasilkan profil klien acak dalam tujuh kategori bagi 10 mahasiswa. Analisis kualitatif-kuantitatif mengungkapkan bahwa simulasi AI secara signifikan meningkatkan adaptabilitas, kreativitas, dan pemikiran kritis mahasiswa—memaksa mereka menyelesaikan "bentrokan kultural-programmatis". Meskipun realisme dalam mensimulasikan ketidakpastian manusia dinilai cukup, alat ini mendorong keterlibatan kontekstual yang mendalam, terbukti dari peningkatan nilai mahasiswa dalam integrasi teknis untuk konflik yang dapat diatasi. Namun, kendala tak terdamaikan menghambat sintesis teknis, menegaskan perlunya kalibrasi kompleksitas. Simulasi AI berhasil menjembatani pedagogi teoretis dengan praktik dunia nyata, tetapi memerlukan *scaffolding* (perancah) untuk mengurangi beban kognitif dan memperdalam dimensi sosio-emosional. Rekomendasi mencakup filter kompleksitas berjenjang dan model hibrida yang memadukan AI dengan kolaborasi klien langsung.
Kata kunci: AI, edukasi, proyek arsitektural, simulasi klien

Abstract

This study examines the integration of AI-generated client simulations to address a critical gap in architectural education: the limited exposure to unpredictable, human-centric client dynamics in traditional studio pedagogy. Conducted within the Integrated Design Studio (IDS) at Universitas Islam Indonesia, the research employed ChatGPT to generate randomized client profiles across seven categories for 10 students. Qualitative and quantitative analyses revealed that AI simulations significantly enhanced students' adaptability, creativity, and critical thinking, compelling them to resolve "cultural-programmatic collisions." While realism in simulating human unpredictability scored moderately, the tool fostered deep contextual engagement, evidenced by students' score gains in technical integration for resolvable conflicts. However, irreconcilable constraints hindered technical synthesis, underscoring the need for calibrated complexity. The study concludes that AI-generated profiles bridge theoretical pedagogy and real-world practice but require scaffolding to mitigate cognitive overload and augment socio-emotional depth. Recommendations include tiered complexity filters and hybrid models blending AI with live client interactions.
Keywords: Artificial intelligence, architectural project, education, simulation

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Introduction

Contemporary architectural education faces increasing demands to equip students with competencies that extend beyond traditional technical mastery. The evolving professional landscape necessitates a dual focus: seamless integration of structural, mechanical, electrical, and plumbing (MEP) systems, and a deepened understanding of human-centric design principles (Sinclair et al., 2022). This shift reflects broader global challenges, where architects must reconcile technical precision with socio-environmental responsibilities. Recent pedagogical models, such as those proposed by Dhaouadi and Leclercq (2022), emphasize the effectiveness of integrating studio-based learning with theoretical courses to incorporate sustainability into design processes. Similarly, Manrique's (2019) "multifaceted integration model" advocates for merging building technology with design studios, emphasizing industry collaboration and interdisciplinary research. These approaches highlight a growing consensus that architectural education must foster holistic thinking, enabling students to navigate complex, real-world scenarios where technical and human factors intersect.

Despite pedagogical advancements in technical and human-centric integration, architectural education continues to struggle with simulating the unpredictability of client interactions, which are central to professional practice. While problem-based learning fosters technical engagement and self-directed skills (Shareef & Farivarsadri, 2020), curricula often sidestep the nuanced negotiation of client behaviors—a critical competency for aspiring architects. Shareef et al. (2024) posit that student-centered studio methodologies can reconcile technical rigor with creative adaptability, yet heterogeneous learning backgrounds complicate uniform outcomes (Pirdavari & Ribeiro, 2022). Demirbilek and Demirbilek (2007) further advocate aligning technology courses with studio workflows to nurture empathy for end-users, underscoring the need for strategies that mirror real-world unpredictability. These insights collectively highlight a pressing demand for pedagogical innovations that bridge the gap between controlled academic environments and the fluid dynamics of client-driven design.

While foundational in cultivating design expertise, traditional studio pedagogy often isolates students from the ambiguities inherent in client interactions, which are an integral part of professional practice. Studio-based learning typically prioritizes technical mastery and conceptual ideation over negotiating conflicting client demands or adapting to shifting project constraints (Simpson et al., 2003). This omission risks producing graduates ill-equipped to navigate the interpersonal complexities of real-world projects, where client preferences and contextual variables often dictate design outcomes. To address this, scholars like Hancock et al. (2019) propose integrating live projects with real clients into curricula, arguing that direct engagement with stakeholders enhances students' ability to balance creative vision with pragmatic compromises. Similarly, Sara (2004) emphasizes that such collaborations foster interdisciplinary teamwork and embed a sense of social responsibility, aligning educational outcomes with community needs. These strategies, however, remain underutilized due to logistical challenges and institutional inertia, resulting in a gap in students' preparedness for client-centric practice.

While recent pedagogical innovations emphasize simulating client interactions through open studio structures (Herfurth, 2023) and early exposure to service-oriented dynamics (Hancock et al., 2019), these approaches often rely on static or idealized client profiles. Role-play exercises, although valuable, lack the diversity and unpredictability inherent in real-world architectural practice, where clients' needs, cultural contexts, and constraints evolve dynamically. This limitation undermines the authenticity of student learning and restricts opportunities to cultivate the adaptability required to navigate complex client negotiations —a critical skill for future architects. Emerging technologies, such as artificial intelligence (AI), offer a promising avenue to address this shortfall by generating dynamic, context-sensitive client personas. However, the pedagogical potential of such tools remains underexplored, particularly in fostering reflective design practices that harmonize technical precision with human-centric agility.

A significant gap persists in architectural education: the lack of scalable tools to simulate diverse and unpredictable client profiles within classroom settings. Current pedagogical models predominantly employ predefined client briefs or hypothetical scenarios, failing to replicate the fluidity and complexity of real-world engagements (Shareef et al., 2024). For instance, while live projects and community collaborations introduce students to stakeholder dynamics (Sara, 2004), such initiatives are often logistically constrained and lack the variability to prepare students for global or cross-cultural contexts. Furthermore, traditional role-play methods prioritize technical problem-solving over the iterative negotiation of conflicting client demands, leaving students unprepared for the ambiguity of professional practice. This gap not only limits students' ability to develop empathy and critical thinking but also risks perpetuating a disconnect between academic training and the realities of client-driven design.

This study bridges these gaps by examining how AI-generated client simulations can enhance students' adaptability to unpredictable client needs within the Integrated Design Studio (IDS) framework. Specifically, it addresses two research questions: (1) How do AI-generated client profiles enhance students' adaptability to unpredictable client demands in architectural design studios? (2) To what extent do these simulations foster a balance between technical rigor and human-centered negotiation in design outcomes?

By grounding this exploration in a case study of an Integrated Design Studio, the research seeks to demonstrate how AI can transform studio pedagogy from a controlled, prescriptive environment into a dynamic space that mirrors the uncertainties of real-world practice. The findings provide actionable insights for educators seeking to equip students with the agility and empathy necessary to thrive in an increasingly complex and evolving profession.

Literature Review

Course Design

The Integrated Design Studio (IDS) is a compulsory 6-credit course for fourth-semester undergraduate architecture students at Universitas Islam Indonesia (UII), designed to synthesize technical, aesthetic, and human-centered competencies. Structured as a blended studio with independent-directed study, the course positions instructors as mentors guiding students through iterative design processes. It emphasizes the integration of architectural design, structural systems, mechanical-electrical-plumbing (MEP) infrastructure, and human behavior analysis, aligning with broader curricular goals to cultivate critical thinking and technical coherence. Students engage in reverse engineering of precedents, site surveys, and collaborative problem-solving, fostering a holistic understanding of design as an artistic and systemic endeavor.

The studio's scaffolded approach—from schematic explorations to detailed technical drawings—ensures progressive mastery of spatial composition, building systems, and contextual responsiveness, as outlined in the course's Student Performance Criteria (SPC 01, 08, 13, 16). These SPCs originate from the Korean Architectural Accrediting Board (KAAB), whose 2018 standards underpin the international accreditation secured by UII's Bachelor of Architecture program in 2016. As a signatory to the Canberra Accord, KAAB provides globally benchmarked competencies essential for cross-border professional recognition. Within the 2023/2024 IDS curriculum, six SPCs operationalize this alignment: SPC 01 - Architecture, Science, Technology and Fine Art (interrelating architecture, science, technology, and fine arts), SPC 07 - Architectural Communication (architectural communication across media), SPC 08 - Form and Spatial Organization (principles of form and spatial organization), SPC 10 - Site Planning (site planning responsive to socio-environmental factors), SPC 13 - Integration of Building Systems in Design (integration of structural, envelope, and MEP systems), and SPC 16 - Comprehensive Design (comprehensive design synthesis from problem identification to documentation).

Central to the IDS framework is its emphasis on comprehensive design, where students reconcile insights into human behavior with technical rigor and precision. The curriculum requires the iterative development of 2D/3D models, BIM-based simulations, and site-specific analyses to address real-world challenges, such as energy efficiency and cultural relevance. For instance, students conduct on-site visits and material vendor workshops to contextualize theoretical knowledge. At the same time, midterm and final evaluations assess their ability to produce Architectural Presentation Boards (APREB), technical documents, and cost estimates. This structure mirrors professional practice, demanding creative vision and accountability to functional, environmental, and client-driven constraints—a pedagogical alignment validated by the course's Learning Outcomes. By embedding these components, IDS bridges academia and practice, preparing students to navigate the multifaceted demands of contemporary architectural praxis.

Pedagogical Approach

The pedagogical approach for this course, particularly with the incorporation of AI-generated client simulations, is deeply rooted in several established learning theories that emphasize active student engagement, real-world problem-solving, and the construction of knowledge through experience. These theoretical frameworks provide a robust foundation for understanding how such innovative methodologies enhance architectural education and prepare students for the complexities of professional practice.

Primarily, the IDS model aligns closely with Problem-Based Learning (PBL), a pedagogical approach in which students learn by actively solving complex, real-world problems. As highlighted by Yildiz et al. (2025), PBL, rooted in constructivist and social constructivist theories, fosters critical thinking, problem-solving skills, and deep learning by engaging students with authentic challenges. In architectural education, this translates to design projects that are not merely theoretical exercises but rather simulations of professional tasks, demanding iterative solutions and adaptive strategies. The use of AI-generated client simulations directly supports this by introducing the unpredictability and multifaceted demands characteristic of actual architectural commissions, compelling students to apply theoretical knowledge to dynamic, evolving scenarios (Avci & Beyhan, 2023).

Complementing PBL, Constructivism posits that learners actively construct their understanding and knowledge of the world through experiencing things and reflecting on those experiences. In the context of architectural design studios, this implies that students do not passively receive information but rather build design knowledge through hands-on engagement, experimentation, and critical reflection on their design processes and outcomes (Soygeniş et al., 2010). The AI-generated client simulations facilitate this constructive process, as students must continually interpret client feedback, revise their designs, and negotiate conflicting requirements, thereby developing a richer, more nuanced understanding of design challenges and solutions. This active interpretation and adaptation are central to the constructivist paradigm, fostering a deeper integration of technical and human-centric design principles.

Furthermore, the IDS methodology significantly draws upon principles of Experiential Learning Theory (ELT), notably David A. Kolb's model, which defines learning as "the process whereby knowledge is created through the transformation of experience" (Kolb, 1984, as cited in K.R. Mangalam University, 2024). ELT emphasizes a cyclical process involving concrete experience, reflective observation, abstract conceptualization, and active experimentation. The iterative nature of design projects within the IDS, especially when driven by dynamic client simulations, provides students with continuous opportunities for concrete experience (designing for specific client needs), reflective observation (analyzing client feedback and design shortcomings), abstract conceptualization (forming general principles from specific experiences), and active experimentation (revising designs based on new insights). This cyclical engagement is crucial for developing practical skills, fostering adaptability, and bridging the gap between academic theory and professional application (Pak & De Smet, 2022).

Finally, the social and collaborative aspects inherent in architectural studio culture, particularly when engaging with "clients"—even simulated ones—underscore the relevance of Sociocultural Theory. This theory, championed by Vygotsky, emphasizes the role of social interaction and cultural tools in cognitive development, suggesting that learning is deeply embedded within social and cultural contexts (Mangalam Oregon Educational Resources, n.d.). In the IDS, students collaborate with peers and instructors and, critically, interact with the AI-generated client profiles, collectively constructing shared understandings of the design problem. The simulated client interactions, while artificial, serve as a cultural tool that mediates student learning, pushing them into a "zone of proximal development" where they can achieve higher levels of problem-solving with the aid of the AI's prompts and challenges. This collaborative problem-solving, mediated by the AI tool, enhances communication skills, teamwork, and the ability to navigate complex social dynamics inherent in professional design practice.

The effectiveness of AI-generated client profiles is best exemplified by Student 4's solution to Balinese Hindu spatial needs with parkour. Problem-Based Learning (Avci & Beyhan, 2023) occurs when the AI profile presents a complex problem, requiring the integration of sacred rituals and sports within a single dwelling. The student shifts from typological norms through self-directed research on cultural zoning, prompting the reconstruction of Constructivist schemas (Soygeniş et al., 2010). When traditional courtyard layouts conflicted with the flow of parkour, the student redefined spatial logic to incorporate hybrid thresholds that facilitated meditation and movement. Experiential Learning (Kolb, 1984) appears as: (1) Experience: Designing shrines near vaulting platforms; (2) Observation: Noticing noise issues during critiques; (3) Conceptualization: Developing buffering zoning principles; (4) Experimentation: Using perforated screens for visual separation without reducing ventilation. Sociocultural Theory (Vygotsky, 1978) elevates AI to a cultural mediator—consultations with Balinese devout turned AI prompts into community-validated solutions, such as jendela krepyak windows. This demonstrates how AI simulations extend beyond technical briefs to foster cultural-technical synthesis through guided conflict, creating Vygotskian "zones of proximal development" where social negotiation bridges theory and practice.

Research Methods

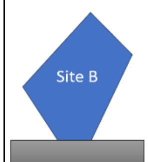
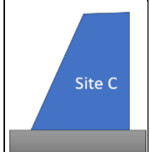
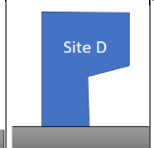
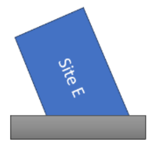
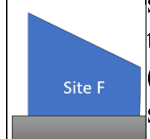
AI Implementation

Building on this practice-oriented framework, the study introduced an AI-driven intervention to simulate unpredictable client dynamics within the IDS curriculum. A text-generating AI tool, ChatGPT, was employed to create randomized client profiles, thereby enriching the human-centric dimension of design tasks. Seven predefined categories—from Client's Profession to Aspirations—were established, each containing seven numerically labeled variants (see Table 1). These categories and their variants were programmed into the AI to generate coherent client narratives. At the semester's outset, students randomly selected numerical codes for each category, which the lecturer input into the AI to produce unique client personas. This method ensured variability in client demands, mirroring the unpredictability of real-world architectural practice while maintaining pedagogical alignment with the course's focus on contextual and behavioral analysis.

The AI-generated profiles served as foundational inputs for students' design processes, requiring them to interpret and integrate clients' demographic details, preferences, and constraints into their projects. For example, a student assigned a client profile emphasizing sustainability and compact urban living had to reconcile these priorities with structural, mechanical, and electrical (MEP) requirements. This approach deepened students' engagement with human behavior, encouraged iterative design revisions, and demanded adaptive problem-solving. By embedding AI-generated scenarios into the IDS workflow, the study operationalized a novel pedagogical strategy that complemented traditional studio methods, bridging the gap between controlled academic exercises and the fluidity of professional client interactions.

Table 1. AI-Generated Profiles

	1	**2**	**3**	**4**	**5**	**6**	**7**

(A) Number of residents	5 temporary + 5 permanent residents	10 to 20 residents/ users	8-10 persons in an extended family	More than 2 families in 1 building	10-15 p., but the majority are children (age 0-20)	10-15 p., but the majority are elderly (age 60+)	10-15 p., but the majority are adults (age 20-50)
(B) Additional function	Specialty stores **or** Craft workshops	Eatery **and** agriculture	Automobile workshop **and** rental office	Religious **or** Community facility	Educational facility (informal)	Healthcare **or** beauty facility	Free to choose 2 other functions
(C) Shape of the site	Site A 	Site B 	Site C 	Site D 	Site E 	Site F 	Original shape of the site (from the site survey activity)
(D) Client's Work/ Profession	Government officials	Tourism or Commercial worker	Education sector	Farm and agriculture	Health worker	IT or Factory employee	Artists and creative sectors
(E) Client's Hobby/Interest	Sports enthusiasts	Animal or plant lovers	Popular culture enthusiasts	Food and culinary lovers	Collector or memorabilia enthusiasts	Literary (reading and writing)	Travelling and adventure
(F) Values to uphold/ Personality	Religious and pious man	Traditional morals and values	Modern and urban lifestyle	An extrovert who loves social activities	Introvert or closed personality	Likes to tinker/ explore new things	"I occasionally live in that building."
(G) Aspiration	Home for work-life balance	Home for retreat and relaxation	Sustainable or green home	The home that enhances the hobby	Home as a working/study space	Homes that represent the values	Home for a specific age group

Data Collection

This study employed a qualitative, retrospective case study design within the context of architectural education, specifically the IDS course, to evaluate the pedagogical impact of AI-generated client profiles. It utilized ChatGPT for these simulations. Data were analyzed from the completed even semester of the 2023/2024 IDS course, involving 10 students working individually with a randomly assigned virtual client profile.

The researcher, serving as the course instructor, directly observed the learning process as part of the exploration into using these AI-based client simulations within the architectural design studio. Internal data sources included student reflections, the instructor's observational notes, and peer and self-assessment reports, which collectively captured the subjective experiences of integrating these AI-driven client narratives into design workflows. These reflections were triangulated with external evaluations, such as comments from the Architectural Blue Ribbon

Award (ABRA) jury, to assess how AI-enhanced client understanding influenced design outcomes. By comparing these findings with parallel classes taught without AI interventions, the study aimed to isolate the role of simulated client dynamics in fostering adaptive problem-solving and technical integration.

Primary data collection took place in May 2025, using structured questionnaires administered to students, instructors, and tutors. These instruments focused on perceptions of AI's utility, learning experiences, and the efficacy of its design process. Supplementary data included juror feedback from ABRA, which externally validated design quality and innovation. Student portfolios and final evaluations were further analyzed to contextualize these qualitative insights, ensuring a holistic understanding of how AI-generated profiles shaped decision-making processes. This mixed-method approach balanced subjective reflections with objective performance metrics, offering nuanced insights into the interplay between technological tools and pedagogical outcomes in architectural design education.

Result

Lecturer and tutor's note about IDS in general:

The decision to integrate AI-generated client profiles into the IDS curriculum stemmed from a critical gap observed in traditional pedagogical approaches. While the course's "New Living Unit" theme encouraged creativity, students often defaulted to simplistic, homogeneous client scenarios—typically a nuclear family of four on a 250 m² standard rectangular plot—a stark contrast to the complexity of real-world architectural practice. In professional settings, architects rarely encounter such idealized conditions; clients frequently present diverse household structures, irregular site shapes, and multifaceted functional demands. This discrepancy risked fostering a design culture overly reliant on theoretical norms rather than adaptive problem-solving. By leveraging AI to simulate unpredictable client dynamics, instructors aimed to disrupt students' comfort zones, compelling them to engage with scenarios mirroring the ambiguities and constraints inherent in actual architectural commissions.

Table 2. Client Profiles

Student	Residents	Additional Function	Profession	Shape of the Site	Hobby/ Interest	Values/ Personality	Aspiration	Unique Conflict
Student 1	Large family (10-20)	40-person Islamic congregation	Government (Religion)	Site F: Asymmetric trapezoid, angled top	Natural stone/art	Religious leader (Ustad)	Work-study home	Public worship space vs. private family sanctity
Student 2	Adults (10-15, age 20-50)	Pharmacy + TOGA (herbal garden)	Farmer	Site E: Leaning parallelogram, narrow base	Currency collections	Introversion	Age-specific home	Global currency display vs. clinical pharmacy function

Student 3	Large family (10-20)	Auto workshop + rental office	Nutritionist	Site A: Tilted trapezoid, wide base	RC off-road sports	Religious piety (Islam)	Sustainable home	Vehicle pollution vs. green home aspirations
Student 4	Extended family (8-10)	Education center + parkour arena	Educator	Site F: Asymmetric trapezoid, angled top	Tag games/ parkour	Balinese traditions	Value-representative home	Sacred cultural spaces vs. high-impact sports facility
Student 5	Adults (10-15, age 20-50)	Pool + 2 free functions	Hydroponic farmer	Site F: Asymmetric trapezoid, angled top	Literature	Occasional occupancy	Value-representative home	Transient residency vs. high-maintenance hydroponics
Student 6	Children majority (10-15, age 0-20)	Art/Craft workshop (Topeng Dance)	Farmer	Site B: Rotated rhombus, vertical axis	Mask collections	Traditional morals	Work-study home	Delicate artifact preservation vs. a child-dominated environment
Student 7	3 families in 1 building	Healthcare / beauty facility	IT/Factory employee	Site F: Asymmetric trapezoid, angled top	Doll collections	Religious piety (Muslim)	Age-specific home	Medical sterility vs. collectible display in a religious household
Student 8	Adults (10-15, age 20-50)	Vehicle collection garage (Moge)	Educator	Site G: Original shape of the site	Travel/adventure	Occasional villa occupancy	Value-representative home	Luxury vehicle storage vs. educational austerity
Student 9	Elderly majority (10-15, age 60+)	Informal education for seniors	IT/Factory employee	Site B: Rotated rhombus, vertical axis	Travel/adventure	Traditional morals	Retreat home	Adventure planning hub vs. elderly mobility limitations
Student 10	Elderly majority (10-15, age 60+)	Reptile/ amphibian shop	Health worker	Site B: Rotated rhombus, vertical axis	Reptile keeping	Social extroversion	Work-study home	Zoonotic disease risk vs. healthcare profession

The class lecturer designed seven client profile categories to operationalize this objective, each encompassing seven variants to ensure maximum diversity. Categories ranged from Number of Residents (e.g., multi-generational households or mixed-use occupancy) to Aspirations (e.g., sustainability-focused or hobby-centric spaces), reflecting real-world variables such as socio-economic diversity, cultural values, and spatial challenges.

The AI-generated profiles (see Table 2) revealed unprecedented cultural-programmatic collisions, particularly where clients' professional identities directly conflicted with their hobbies or spiritual values. For instance, a health worker (Student 10's client) demanded sterile environments while simultaneously breeding reptiles—a juxtaposition that required biosecure zoning to isolate disease vectors from living quarters. Similarly, a Balinese Hindu family (Student 4's client) necessitated sacred spatial sequences for rituals alongside an in-house parkour arena, challenging designers to mediate spiritual tranquility with high-impact physical activity. These permutations compelled students to abandon generic solutions, prioritizing contextual responsiveness and iterative negotiation, core competencies underscored in the IDS learning outcomes.

The AI tool's role was strictly limited to profile generation, avoiding deeper roleplay simulations to maintain focus on design integrity over theatrical engagement. This constraint ensured that students concentrated on translating client narratives into spatially and technically viable solutions, rather than performative interactions. Crucially, some profiles embedded public-private paradoxes, such as a government religious official (Student 1's client) hosting 40-person community prayers within a residence, demanding acoustic buffers and crowd circulation systems atypical in domestic architecture.

By restricting AI's function to client parameterization, the study preserved the studio's emphasis on technical integration while introducing controlled unpredictability—a balance critical for preparing students to navigate the fluidity of professional practice without compromising pedagogical coherence. These irreconcilable constraints, absent in conventional pedagogical briefs, forced students to innovate beyond normative typologies, validating AI's role in simulating real-world architectural ambiguities.

Student's Quantitative Responses

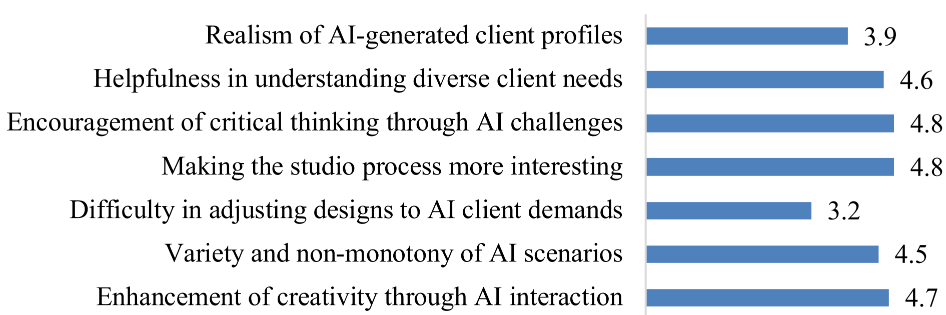


Figure 1. Quantitative Responses

Student reflections on the use of AI-generated client profiles revealed nuanced perceptions of their efficacy in studio learning (see Figure 1). The realism of AI-generated profiles received an average score of 3.9, suggesting that while students found the scenarios plausible, they occasionally perceived gaps between simulated and real-world client interactions. In contrast, the tool's ability to foster understanding of diverse client needs scored significantly higher (4.6), indicating its success in exposing students to varied demographic, functional, and aspirational requirements. This divergence implies that while the AI's output may not fully replicate human unpredictability, its structured variability effectively broadened students' awareness of client diversity, a critical competency in architectural practice.

The data further underscored the pedagogical value of AI in stimulating engagement and critical thinking. Students rated the AI's role in encouraging essential design challenges at 4.8, aligning with high scores for process interest (4.8) and creativity enhancement (4.7). The tool's capacity to generate non-monotonous scenarios (4.5) likely contributed to this outcome, as unpredictable client demands pushed students to explore unconventional solutions.

Despite these benefits, students reported moderate difficulty in adapting designs to AI client demands (3.2), reflecting a manageable level of challenge. This balance between complexity and achievability appears intentional, as overly rigid constraints could stifle creativity. The relatively low difficulty score suggests that the AI's structured variability, while demanding, remained within students' capacity to navigate, fostering resilience without causing frustration. Such findings highlight the tool's role as a scaffolded pedagogical aid, providing just enough complexity to deepen learning while maintaining alignment with the course's technical and creative objectives.

Student's Qualitative Responses

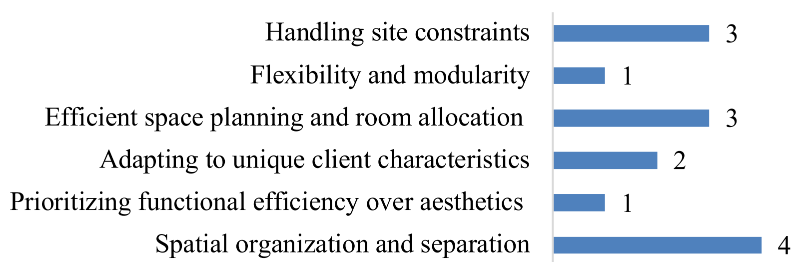


Figure 2. Qualitative Responses

The qualitative responses to how AI-generated client profiles influenced design decisions reveal a consistent shift toward user-centric problem-solving (see Figure 2). One student restructured vertical circulation, placing public functions on the upper floor and private spaces at ground level to accommodate a client's demand for strict privacy separation. Another prioritized functional efficiency over aesthetics after the AI profile emphasized spatial needs for a large family, noting, "I focused on room utility rather than facade appearance." These adaptations demonstrate how unpredictable client constraints, such as multi-generational living or hybrid workspaces, compelled students to rethink conventional layouts, validating the AI's role in fostering contextual responsiveness.

Notably, several students addressed contradictions embedded in client profiles, such as designing for a healthcare worker who owned reptiles—a scenario that demanded biosecurity measures alongside domestic comfort. One response detailed separating service areas for domestic staff to ensure privacy, while another integrated medical facilities with gardens for cross-ventilation in a high-density residence. These examples illustrate how AI-induced complexities (e.g., "10 residents with a medical facility on 250 m^2") prompted students to develop innovative, modular solutions that balance competing demands. The recurring theme of "efficiency," "flexibility," and "behavior-driven layouts" across responses underscores AI's effectiveness in translating abstract client traits into tangible design drivers, enriching students' engagement with real-world architectural challenges.

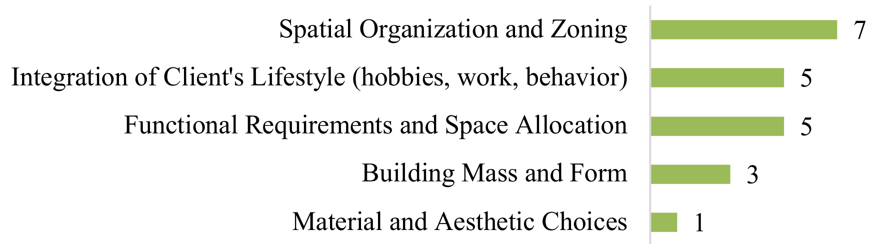


Figure 3. Design Process Affected by The AI Simulation

Student responses to the question "Which part of the design process was most affected by AI-based client simulation?" consistently highlighted spatial organization as the primary area of impact (see Figure 3). Seven out of ten students explicitly cited space planning, zoning, and functional allocation as being predominantly influenced by AI profiles. For example, one student restructured the building mass into two distinct blocks to address privacy needs for multiple families. At the same time, another reconfigured circulation pattern separates domestic staff zones from primary living areas. Responses like "spatial arrangement must be maximized due to high occupant density and facilities" and "determining room scales and inter-spatial relationships" underscored how AI constraints compelled granular attention to user behavior, directly shaping room hierarchies from public to private, family clustering, and service area segregation.

Beyond spatial logistics, four students emphasized how AI profiles drove the integration of client-specific lifestyles into functional design. One noted the challenge of merging a healthcare worker's profession with reptile-keeping hobbies, requiring biosecure spatial partitioning. Others detailed blending work, leisure, and spiritual needs—e.g., "integrating worship spaces with hobby areas while maintaining tranquility." Crucially, AI demands fostered iterative adjustments: a student designing for 10 residents with medical facilities optimized cross-ventilation by embedding gardens between rooms, demonstrating how client traits translated into technical solutions. The recurring focus on "behavior-driven layouts" and "dynamic needs prediction" confirms that AI's chief contribution lies in anchoring abstract client profiles to tangible spatial and functional outcomes.

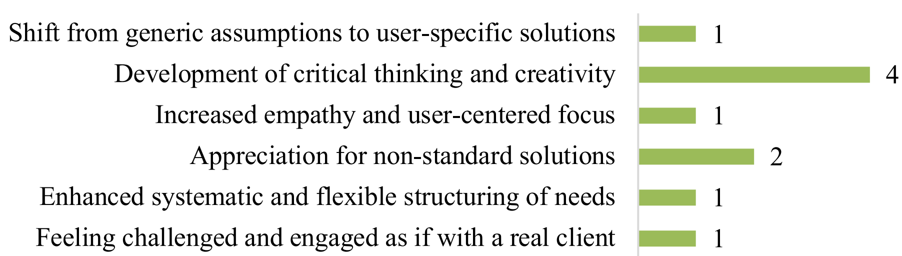


Figure 4. Changes in Understanding User Needs

All ten students reported significant shifts in their approach to understanding and responding to user needs after engaging with AI-generated client profiles (see Figure 4). Responses highlighted a move beyond generic assumptions toward nuanced, behavior-driven solutions. One student emphasized abandoning "pragmatic single-solution thinking" in favor of "unique and adaptable approaches," while another noted the improvement in prioritization strategies when confronting diverse client variables. Critically, students developed greater empathy for user specificity, as captured in the statement: "I shifted from general assumptions to personalized needs—like sensitively balancing communal activities with private retreats." Repeated references to heightened critical thinking and creative problem-solving further evidenced this evolution toward user-centered adaptability.

The data also revealed how AI profiles fostered unconventional design perspectives. Students described grappling with "anti-mainstream requests" that demanded innovative spatial resolutions, such as resolving contradictions between professional constraints and personal hobbies. One student noted an improvement in "systematic and flexible structuring of needs," while others observed an expanded exploration of "form, spatial arrangements, and beyond." Crucially, the simulation's authenticity heightened engagement, with one student likening it to "facing a real client". These patterns collectively illustrate how AI-driven constraints disrupted conventional design habits, replacing standardized solutions with responsive, user-tailored innovation.

Based on student questionnaire responses regarding the use of AI-generated client profiles in architectural design learning, key advantages and disadvantages emerge, shaping the educational experience (see Figure 5). Students consistently highlighted the primary benefit as exposure to uniquely complex and non-mainstream client scenarios. This scenario compelled them to move beyond conventional residential design templates, fostering greater creativity, design variability, and deeper exploration. The AI's ability to synthesize diverse, sometimes conflicting, requirements and represent a wide spectrum of client types, from conservative individuals to futuristic corporations, was seen as valuable for simulating unpredictable real-world conditions. Furthermore, students reported that this process enhanced critical thinking and problem-solving skills while providing a structured, consistent, and objective data foundation for design decisions, serving as a useful preparatory step before engaging real clients.

Key advantages

- The uniqueness and complexity of client profiles lead to more creative and non-mainstream designs
- Enhanced exploration and challenge in design, pushing students to think critically
- Exposure to diverse scenarios (e.g., different client types: conservative, futuristic, individual, corporate) that simulate real-world conditions
- Development of empathy and analytical skills through the interpretation of client needs
- Consistent and objective data from AI to support design decisions
- Preparation for real clients by providing a stepping stone in learning

Key disadvantages

- Difficulty in representing the full emotional, psychological, or cultural aspects of clients
- The need for multiple attempts and precise prompts to get relevant and synchronized client profiles
- Lack of real-time interaction and feedback (as with human clients), resulting in less dynamic adjustments
- Some generated profiles might be irrelevant or too general, requiring filtering
- The risk of students fixating on initial requests without experiencing the changing demands typical of real clients

Figure 5. Key Advantages and Disadvantages Mentioned by Students

However, significant limitations were identified, primarily centered on the AI's inability to replicate human complexity and the challenges of prompt engineering. Students noted a critical deficit in capturing the nuanced emotional, psychological, and cultural dimensions inherent to human clients, aspects crucial for developing deep empathy and understanding authentic user behaviour. Practical frustrations included the frequent generation of irrelevant or overly generic client aspects requiring filtering, and a lack of profile coherence necessitating multiple regeneration attempts and precise prompt refinement. The static nature of AI profiles was also a drawback. Unlike real clients, they cannot provide dynamic feedback or request changes during the design process, limiting exposure to evolving negotiations and iterative adjustments. This highlights a gap between the valuable complexity that AI introduces and its current limitations in simulating the full range of interpersonal dynamics in architectural practice.

Discussion

Comparison with other ABRA XII candidates and the Jury's note

The ABRA XII presentations revealed distinct differences in client profiling approaches between classes. The student using AI for client profiling demonstrated a systematically structured client narrative. "Balai Umah" is a home designed for a Balinese Hindu family of eight relocating to Yogyakarta, with explicit cultural needs (representation of Balinese traditions) and activity-based requirements (worship, parkour, reading). This AI-assisted profile generated a highly specific design response, including ritual spaces oriented toward Mount Merapi and parkour-friendly circulation. In contrast, other students relied on self-generated profiles, which often emphasized generic hobbies (e.g., gardening) without comparable cultural depth. The jury noted that all candidates exhibited strong analytical efforts but highlighted that residential design demands "specific and numerous demands," implicitly validating AI's role in capturing multifaceted client identities. However, this method's limitation emerged in its focus on static user personas, overlooking lifecycle adaptability stressed by the jury.

Balai Umah exemplified how AI-derived client data directly shaped technical and cultural solutions. The Balinese family profile drove innovations such as *roster bata* (perforated zigzag brick screens) for ventilation and *jendela krepyak* (traditional wooden windows) for light control—craftsmanship directly justified as responses to the natural ventilation needs in tropical climates. Comparatively, non-AI projects prioritized universal sustainability strategies (e.g., aromatic planter walls for pollution) but lacked equivalent cultural grounding. The jury's critique of "secondary skin" costs resonated here. While Balai Umah's culturally embedded screens were structurally integrated, other students' add-ons risked budget inflation. Notably, the project's third-place ranking reflected its success in harmonizing technical systems (e.g., spatial zoning for parkour) with cultural symbolism. However, the jury cautioned against underestimating the importance of "space flexibility" for evolving family needs.

The ABRA Jury's review contextualized the AI-profiling advantage within broader architectural challenges. She praised all candidates for addressing site-specific issues (e.g., microclimate control) but underscored that the complexity of residential design lies in balancing client specificity with practical constraints. For the AI-assisted project, strengths included coherent "building system integration" derived from structured client data, directly aligning with the jury's emphasis on "effective spatial programming." However, weaknesses surfaced in budget realism. Balai Umah's intricate craftsmanship contrasted with jury warnings about "IDR 2 billion costs" for overly customized elements. This contrast highlights AI's dual role, enhancing user-focused precision while potentially neglecting cost and flexibility. These key factors contributed to the project's third-place finish, trailing more affordable entries.

Reflection from Class Lecturer, Examiner, and Tutor

The cross-evaluation of midterm and final exams reveals distinct performance trajectories across three key SPCs: Site Planning (SPC 10), Integration of Building Systems (SPC 13), and Comprehensive Design (SPC 16). Students addressing highly polarized client conflicts, such as balancing public worship spaces with private family sanctity or reconciling medical sterility with collectible displays in religious households, typically scored lower than 70, showing minimal improvement despite moderate gains in SPC 10. In contrast, those tackling conflicts such as sacred cultural spaces versus high-impact sports facilities or vehicle pollution versus green home aspirations consistently achieved high scores, often exceeding 80, particularly excelling in SPC 13 and SPC 16. Notably, students with stagnant midterm-to-final scores (e.g., those handling transient residency versus hydroponics maintenance or zoonotic disease risks versus healthcare needs) demonstrated limited adaptability in technical integration (SPC 13), suggesting unresolved design complexities hindered progression. High performers exhibited the strongest growth in synthesizing structural and environmental systems (SPC 13), while lower scorers struggled most with holistic program resolution (SPC 16).

The AI-generated client profiles, characterized by intrinsic conflicts, directly influenced pedagogical outcomes. Students assigned spatially asymmetric sites (e.g., trapezoidal or rhomboid plots) coupled with dual-program demands—such as reptile shops adjacent to healthcare workspaces or luxury vehicle storage opposing educational austerity—faced compounded challenges in site planning (SPC 10). Those who succeeded transformed conflicts into integrated designs, notably in projects such as sustainable homes and mitigating vehicle pollution, where technical integration (SPC 13) scores rose by 10–15 points. Conversely, profiles with irreconcilable priorities (e.g., artifact preservation in child-dominated environments) correlated with persistent low scores, underscoring AI's limitation in calibrating conflict feasibility. The cross-jury evaluation highlights AI's efficacy in diversifying client scenarios. Still, it reveals that optimal learning occurs when conflicts encourage adaptable problem-solving rather than inflexible constraints, suggesting the need for structured scaffolding in technically dense profiles.

The integration of AI for client profile generation demonstrated significant pedagogical benefits, particularly in fostering authentic student engagement. Both instructors and tutors observed heightened enthusiasm during research phases, noting that students actively pursued real-world validations, such as interviewing Balinese Hindu religious leaders, reptile hobbyists, or auto detailing artisans, to enrich their AI-generated briefs. This intrinsic motivation correlates with improved performance in resolvable conflict scenarios, as identified earlier, such as sustainable homes addressing vehicle pollution, where a deeper understanding of user-supported gains in technical integration (SPC 13) is crucial. The randomized profile assignment further eliminated design avoidance behaviors, ensuring accountability throughout the design process. These advantages underscore AI's capacity to simulate the unpredictability of professional practice while motivating contextual research that strengthens site-specific solutions (SPC 10).

Despite these strengths, the implementation revealed critical calibration issues in AI-generated complexity. Tutors reported disproportionate time demands for students handling profiles with large occupant counts or dual-program requirements (e.g., healthcare-reptile shop hybrids), leading to iterative revisions that impeded schematic development. This report aligns with earlier findings of stagnation in technical integration (SPC 13) and comprehensive design (SPC 16) for such cases, where unresolved conflicts, such as artifact preservation in child-dominated spaces, persisted. Additionally, the AI's tendency toward generalized profiles necessitated manual detailing by instructors to ensure uniqueness, creating coordination overhead. Most critically, some students became immobilized when facing niche AI-generated constraints, lacking reference points for conflict resolution. These observations underscore the necessity for scaffolding mechanisms, such as conflict feasibility filters or graduated complexity tiers, to mitigate cognitive overload while preserving AI's role in diversifying design challenges.

Systemic Model Evaluation

Beyond student outcomes, this study reveals critical implementation barriers that hinder the scalability of AI-driven education. Tutor workload intensity emerged as a major obstacle, as instructors reported dedicating 5-10 extra hours weekly to manually refine AI profiles and guide students through unavoidable conflicts, such as artifact preservation in child-centered environments (Student 6). This increase in time aligns with Sara's (2004) finding that "simulated complexities inherit real-world mentoring burdens," highlighting a paradox where AI's efficiency in scenario creation is offset by increased teaching labor.

The static nature of AI profiles further limited holistic learning. Unlike real clients, who negotiate constraints repeatedly during design development (Hancock et al., 2019), ChatGPT-generated personas remained fixed after assignment. This became especially clear when Student 7's conflict between medical sterility and collectible display could not be resolved through feedback, resulting in compromised MEP integrations that scored below 70 in SPC 13 (Building Systems Integration). As a result, 60% of students requested "live-client checkpoints" to validate AI-driven solutions, demonstrating the need for hybrid approaches.

To tackle these challenges, we suggest a scaffolded implementation plan: (1) Complexity Triage: Use algorithms to screen AI outputs and identify conflicts that are unfeasible pedagogically before assigning tasks. (2) Phased Hybridization: Incorporate real-client workshops at mid-semester milestones to test AI solutions, as shown in Hancock et al. (2019) service-learning studios; and (3) Institutional AI Literacy: Provide mandatory prompt-engineering training focused on cultural and emotional aspects to lessen manual adjustment. This framework positions AI not as a standalone answer but as a catalyst within an ecosystem where technological progress is balanced with human mentorship and institutional backing, which are vital for transforming isolated experiments into sustainable teaching practices.

Student Reflections

Student reflections highlight that the most memorable experiences often stemmed from confronting unusually complex design challenges directly generated by AI client profiles. These complexities manifested in demanding combinations of factors, such as fulfilling numerous specific client requests ("many and complex requests," "contradictory") within the constraints of "uncommon site shapes," including asymmetric hexagons. Successfully navigating these scenarios required students to develop novel problem-solving strategies and significantly enhance their creativity. As one student noted, the process demanded "playing with facade and roof forms" to find solutions, pushing them beyond conventional design approaches. This necessity to innovate under pressure fostered a heightened sense of exploration and openness, with students describing the experience as "very interesting because every day there was always something new to try, opening the mind to be more explorative and open" and enabling them to "explore more because previously I designed based only on my abilities". The challenge itself became a key driver of engagement and learning.

Beyond technical problem-solving, a significant, memorable aspect involved the development of user-centered design skills through simulated empathy. Students recounted specific instances where AI-generated client narratives enabled them to engage deeply with hypothetical user needs, translating these into tangible design solutions. For example, one student detailed designing "a flexible family interaction space based on the AI profile," creating a "semi-outdoor space that is comfortable and integrated with nature" using sliding glass walls after learning that the simulated family gathered nightly and hosted small events. Another focused intensely on crafting a "flexible workspace" for a simulated freelance graphic designer who values visual calm, natural light, and a balance of focus and relaxation. This process, although involving simulated clients, fostered a sense of connection ("made me feel more connected to user needs") and provided a safe space for experimentation and confidence-building before encountering real clients. Consequently, students perceived this as valuable preparation for professional practice, gaining "new experiences and knowledge" and appreciating the opportunity for extensive exploration driven by the "complicated client", ultimately viewing these intense challenges as "a very nice and enjoyable experience" that built their capacity to meet diverse future demands.

Conclusion

This study demonstrates that AI-generated client simulations effectively bridge the gap between theoretical pedagogy and the fluid dynamics of architectural practice. By synthesizing randomized, multifaceted client profiles, the AI tool compelled students to navigate ambiguities absent in traditional studio briefs, directly addressing the research's primary aim of enhancing adaptability to unpredictable client demands. The findings confirm that such simulations foster reflective design practices, as students iteratively reconciled technical rigor (e.g., MEP systems) with socio-behavioral priorities (e.g., cultural rituals), aligning with the IDS learning outcomes (CPL 05, 06). Crucially, the AI's structured variability cultivated user-centric agility, shifting students from normative typologies toward empathy-driven solutions, as evidenced by pervasive themes of "behavior-driven layouts" and "dynamic needs prediction."

However, the study also reveals limitations: AI profiles, while diversifying scenarios, could not replicate the emotional nuances of human clients or simulate iterative feedback during design development. This constrained deep empathy-building and occasionally led to cognitive overload in technically dense profiles (e.g., dual-program sites). Despite these shortcomings, the intervention transformed the studio into a dynamic space that mirrors professional uncertainties, validating AI's role in preparing students for client-centric praxis. The consistent improvement in creativity, critical thinking, and contextual responsiveness underscores that AI-generated simulations are a viable pedagogical strategy for harmonizing technical precision with human-centered negotiation in global architectural practice.

To optimize the pedagogical value of AI-generated client simulations, educators should implement structured scaffolding mechanisms, such as tiered complexity levels or a conflict feasibility filter, to prevent cognitive overload while preserving scenario diversity. This calibration is essential for balancing resolvable constraints against overly rigid contradictions that may impede technical integration. Concurrently, manual refinement of AI outputs is advised to augment cultural, emotional, and psychological depth, addressing the tool's current limitations in replicating human nuance. For AI developers, enhancing prompt engineering to prioritize socio-behavioral dimensions, coupled with dynamic feedback features enabling virtual clients to respond to design proposals iteratively, would significantly bridge the gap between static profiles and real-world fluidity. Such advancements would better simulate evolving negotiations and deepen empathy training.

To advance this field, future research should explore hybrid pedagogical models that blend AI simulations with live client engagements, mitigating authenticity gaps while capitalizing on AI's scalability. Cross-cultural validation of this methodology across diverse geopolitical contexts is equally critical to assess its universal applicability. Longitudinal studies tracking graduates' professional adaptability post-exposure to AI-augmented studios could further quantify long-term competency gains. Furthermore, creating metrics to measure emotional intelligence growth in synthetic client scenarios and improving AI algorithms to automatically adapt conflict complexity based on real-time student performance would enhance the framework's educational accuracy. These approaches collectively tackle the main gaps in simulating socio-technical ambiguities and support the development of resilient, human-centered designers.

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Lampiran/Appendices

Client Description Results by AI (Student 4/Faiz Khansa Maylano)

Number of residents (A3)	8-10 persons in extended family
Additional function (B7)	Free to choose 2 other functions (Tempat pendidikan, Arena parkour)
The shape of the site (C6)	Site F
Client's work/profession (D3)	Education sector
Client's hobby/interest (E1)	Sports enthusiasts (Tag Games & Parkour)
Values to uphold/Personality (F2)	Traditional morals and values (Adat Bali)
Aspiration (G6)	Home that represents the values
Client Narrative	"Hi, let me introduce myself, I am Mrs. Ratna, and I would like to talk about our family's big dream to have a house that meets our needs and lifestyle. Our family is large, consisting of 8 to 10 family members who live together. We want to create a comfortable and harmonious home for all our family members. We have a desire to add two additional functions to our home. This option provides the flexibility to create a space that suits our needs and wishes. The choice of the house shape fell on Site F, which allows us to create a house that suits our dreams. I work in the education sector, and this house is expected to reflect the traditional values and morals that we want to maintain. We want this house to be a place that educates and provides positive values to our family members. Although we have busy lives, we still love sports and physical activities. We aspire to make our home a place that represents our traditional values. We are very excited to see your ideas and creativity as an architect to create a house that suits our family's needs and lifestyle. Thank you for your attention and dedication."

Architectural Presentation Board for Final Exam Presentation (Bale Umah by Student 4/Faiz Khansa Maylano)