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Journal of Asian Architecture and Building Engineering

ISSN: 1346-7581 (Print) 1347-2852 (Online) Journal homepage: www.tandfonline.com/journals/tabe20

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To cite this article: Neslinur Hızlı Erkılıç (2026) Integrating inquiry-based learning into architectural design studios: toward a flexible framework, Journal of Asian Architecture and Building Engineering, 25:6, 6047-6067, DOI: 10.1080/13467581.2026.2639102

To link to this article: https://doi.org/10.1080/13467581.2026.2639102

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Published online: 01 Mar 2026.

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JOURNAL OF ASIAN ARCHITECTURE AND BUILDING ENGINEERING
2026, VOL. 25, NO. 6, 6047–6067
https://doi.org/10.1080/13467581.2026.2639102

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Integrating inquiry-based learning into architectural design studios: toward a flexible framework

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ABSTRACT

Since the 2010s, architectural education has faced increasing criticism, highlighting the marginalization of research and theoretical inquiry within design studios dominated by visual and representational approaches. Insufficient integration of inquiry-based methods is argued to hinder the internalization of design knowledge. To address this gap, this study proposes a flexible inquiry-based framework aimed at enhancing students' research and inquiry skills within architectural design studios. Grounded in the theoretical context of inquiry-based learning (IBL) as a form of active learning, this study examines how research-oriented pedagogies can be afforded to studio-based education. Empirical data were collected through surveys conducted with 28 educators and 54 students from the Architectural Design 4 Studio at Yildiz Technical University. Quantitative and qualitative analyses enabled a comparative evaluation of the pedagogical structures, learning outcomes, and inquiry practices. The findings revealed a strong consensus on the value of inquiry in fostering autonomy, critical thinking, and creativity. However, persistent challenges remain in linking research with design development and managing studio time and infrastructural constraints. In response, a 14-week phased framework is proposed, aligning inquiry tasks with learning resources and assessment strategies. This study contributes a transferable model for embedding inquiry-driven learning in architectural studios, promoting reflective, research-oriented, and learner-centered pedagogy.

ARTICLE HISTORY
Received 7 November 2025
Accepted 18 February 2026

KEYWORDS
Architectural design studio; architectural education; design knowledge; inquiry-based learning; learning method strategies

1. Introduction

1.1. Context and research problem

Recent scholarship has increasingly criticized the persistence of pedagogical approaches in architectural education grounded in the master-apprentice model, in which teaching is frequently reduced to the transmission of predetermined knowledge (Cabalfin 2015; Rybczynski 2009; Salama 2015; Schumacher 2021; Wozniak 2016). Empirical work argues that such inherited studio routines are inadequate for coping with the complexity, uncertainty, and interdisciplinary demands of contemporary architectural practice (Akgün 2016; Güner 2016; Madan and Mathur 2025; Rybczynski 2009; Salama 2016; Shaqour 2021; Wrightsman and Everts 2015).

Since the 2010s, growing criticism has further highlighted that the marginalization of scientific inquiry and discovery in architectural design studios, combined with the absence of theoretical grounding, has hindered the internalization of design knowledge. Therefore, acquiring research-inquiry skills during the early phases of the design studio is crucial for cultivating a student-centered process shaped by knowledge, discovery, and decision-making. In response to these concerns, design studios have increasingly evolved into experimental arenas, where diverse pedagogical approaches are explored to address shifting educational needs.

Within this broader debate, the literature emphasizes models that mobilize research and inquiry as mechanisms for transforming studio pedagogy. These include self-regulated learning (Zimmerman 2002), participatory and co-creation design pedagogies that foreground collaborative processes (Sanders and Stappers 2008), problem-based learning designed to foster inquiry (Bridges 2007), transformative pedagogy grounded in critical pedagogy (Salama 2016), open pedagogy that positions students at the center of the learning process (Werth and Williams 2022), scenario-based pedagogies that simulate professional contexts (Stone and Sanderson 2022), and the risk-taking radical pedagogies re-examined through the educational experiments of the 1960s and 1970s (Colomina et al. 2022). Recent studio-based studies have also highlighted the role of assessment and feedback practices

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(Doheim 2025), hybrid digital tools that support creativity and cognitive development in inquiry processes (Al-Rqaibat, Al-Nusair, and Bataineh 2025), and comparative evaluations of studio pedagogies (Anteet and Binabid 2025). These approaches may be read as contextual extensions of experiential learning theories advanced by Kolb (1984) and Schön (1983, 1987). Collectively, they reposition the design studio not merely as a site of production but as a learning environment that cultivates critical thinking, adaptability, and creativity through inquiry.

1.2. Aim and structure of the study

This study explores learner-educator roles and the pedagogical potential of inquiry-based learning (IBL) in architectural studio education. Building on this premise, the principal aim of this study is to develop a framework model that fosters the advancement of students' inquiry capabilities within architectural design studios. As a complementary objective, this study seeks to make visible the interwoven layers of studio practices, expectations, and goals, thereby offering a critical diagnosis of the current state of studio pedagogy and assessing the applicability of contemporary pedagogical approaches within conventional studio settings. Adopting a learner-centered perspective on design education, the study formulates the following guiding research question to orient both the conceptual framing and the empirical fieldwork: How can an IBL method be integrated into a conventional design studio environment, and through which steps?

Accordingly, this study proposes a semester-long studio trajectory structured around core IBL components, outlining how inquiry can be embedded within an existing studio program through sequenced tasks, guidance, assessment, and dissemination.

The research design comprises three sequential phases (Figure 1), with the stages and methods outlined as follows:

(1) *Conceptual Framework*: Within the scope of the literature review, approaches to active learning environments, learner – educator relationships, and inquiry-based learning (IBL) were examined. Based on these findings, a set of guiding principles was established to structure inquiry-oriented pedagogical strategies.
(2) *Case Study*: The case study focuses on Architectural Design Studio IV (AD4) at Yildiz Technical University, a fifth-semester studio that functions as a curricular threshold. At this stage, students are expected to apply foundational design knowledge and strengthen their capacities for individual research, interpretation, and justification. Following an account of the studio's structure and pedagogical practices, a two-stage survey was administered to both instructors and students, designed around themes derived from literature. The study was reviewed by the Ethics Committee of Social and Human Sciences Research at Yildiz Technical University (meeting date: October 3, 2022; meeting number: 2022.10), which confirmed that it

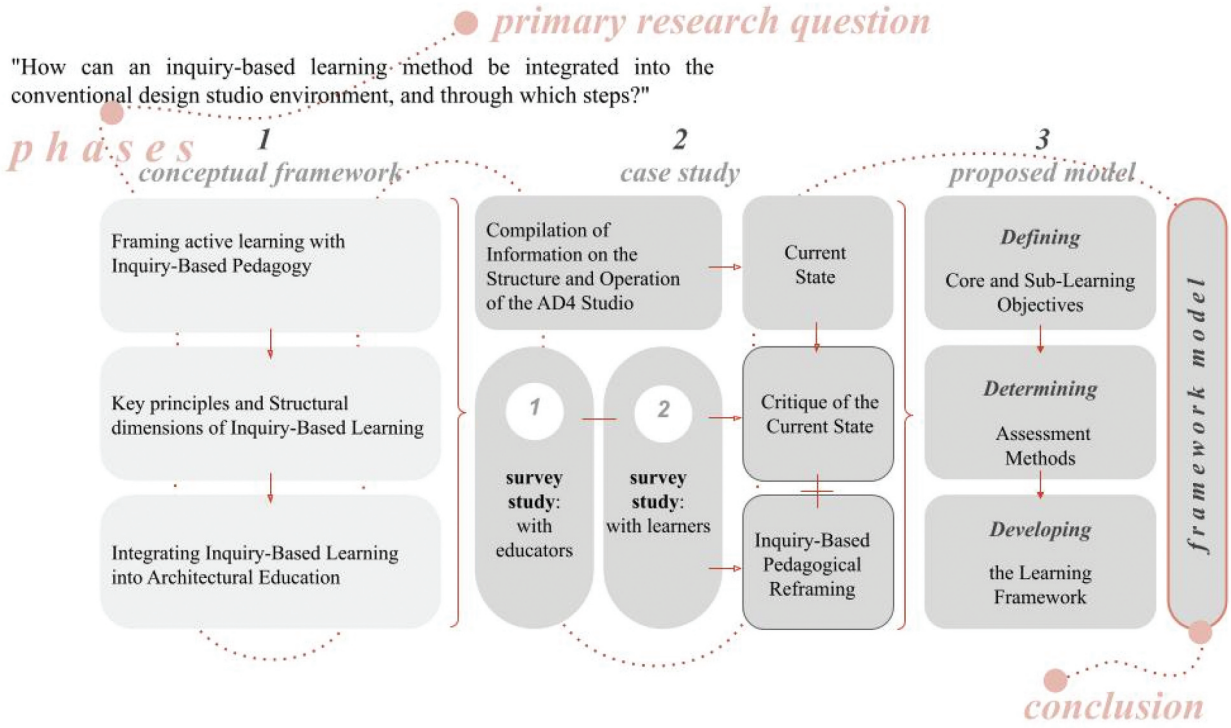

Figure 1. Structure of study.

did not involve any procedures requiring further ethical consideration. Written informed consent was obtained from all the participants. The findings are presented through comparative visualizations that highlight the convergences and divergences between educator and learner perspectives across core IBL components.

(3) *Proposed Framework Model*: The final phase introduces the framework model developed through this study, which recontextualizes the AD4 studio program and its practices, considering empirical insights. The model aims to integrate inquiry-oriented strategies into the studio structure to strengthen students' inquiry capabilities. It is articulated around three core steps: defining overarching and subsidiary learning objectives, determining assessment strategies to ensure fairness and accountability, and developing a sequenced pedagogical trajectory that structures the studio process throughout the semester.

2. Conceptual framework

2.1. Framing active learning with inquiry-based pedagogy

In the twenty-first century, educational paradigms have increasingly shifted from the transmission of established knowledge to the cultivation of inquiry as a mode of learning. However, in architectural education, the systematic development of research, inquiry, and critical reflection remains uneven, often constrained by instructor-centered studio traditions and product-focused assessment practices. As learning environments are reshaped by technological and disciplinary transformations, this misalignment is becoming increasingly visible and pedagogically consequential.

Von Meiss (1995) critiques the conventional hierarchical model of architectural education, in which the instructor is positioned as the primary authority and the student as a passive recipient of knowledge. Instead, learning is reframed as a dialogical partnership between an "experienced" and an "inexperienced" participant, both engaged in questioning what constitutes knowledge. Yürekli (2019) similarly critiques learning practices based on the uncritical observation of what is done and by whom, characterizing them as a passive mode of learning accepted without inquiry. This position aligns with Freire's "banking model" of education, which reduces students to receptacles of deposited information, in contrast to problem-posing pedagogy that positions learners as active, critical subjects engaged in questioning and meaning-making (Freire 2013).

The separation of knowledge from skills further constrains the inquiry within studio education. While learning-by-doing is widely recognized as a productive pedagogical approach, studio practices often leave limited room for sustained inquiry and critical reflection (Brady 2021). Consequently, studio teaching should not be oriented solely toward final products; it should also cultivate multidimensional thinking and design problem-solving logic. Pinheiro (2009) argues that this shift requires rethinking not only instructional methods but also what counts as architectural knowledge, moving beyond the replication of forms toward their intellectual and cultural grounds. Similarly, Wang, Xiao, and Bao (2018) contend that inspiration-led approaches may marginalize scientific research and discovery in architectural education. Recent pedagogical studies advocate process-oriented and inquiry-driven studio frameworks that foreground critical inquiry, reflection, and experiential engagement while acknowledging the practical constraints of institutional structures and studio cultures (Salama and Holgate 2025; Xhambazi and Aliu 2024).

Student-centered pedagogy is broadly grounded in constructivist assumptions, positioning learning as an active process in which students build understanding through engagement, critique, and problem-solving rather than through one-way transmission. Within this active-learning paradigm, Inquiry-Based Learning (IBL) functions as a research-oriented approach that invites students to formulate questions, investigate complex issues, and produce defensible interpretations or proposals. Through varying degrees of scaffolding, IBL gradually shifts the responsibility from instructor guidance to learner autonomy (Lee 2004; Spronken-Smith et al. 2012) (Figure 2). As inquiry outcomes are commonly articulated through critiques, reports, or other representational forms, IBL frames knowledge as something tested, negotiated, and shared within studio culture (Branch and Solowan 2003).

Taken together, these critiques suggest that studio-based learning does not automatically generate inquiry; it requires an explicit pedagogical structure that renders questioning, evidence-seeking, and reflection both assessable and observable. Building on this premise, the following sections synthesize core IBL principles and specify how they are operationalized in architectural design studios in the context of this study.

2.2. Key principles and structural dimensions of IBL

Rather than presenting IBL as a single method, this section examines key models through four studio-relevant lenses: inquiry cycles, levels of guidance, agenda setting, and modes of outcome sharing. One of the early process-oriented inquiry models was

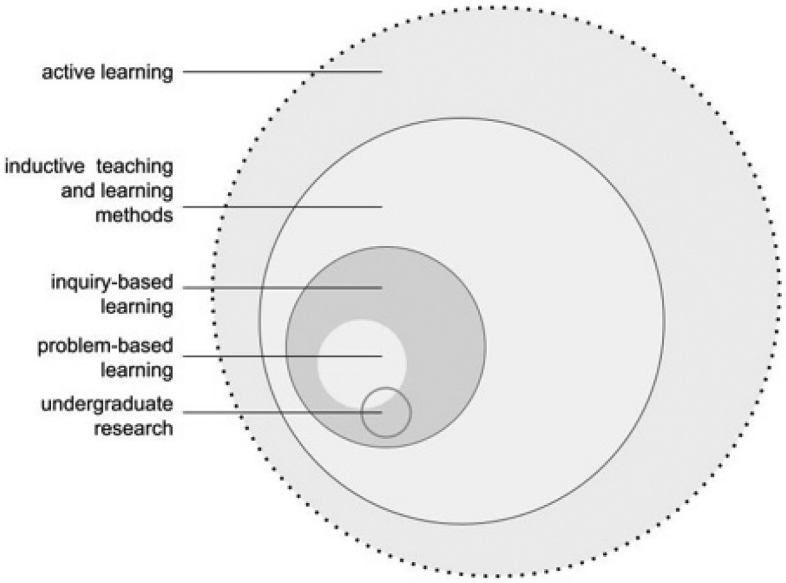

Figure 2. Active learning and its subsets, adapted from Lee (2012) and Spronken-Smith et al. (2007).

developed by a group of McMaster University instructors (Justice et al. 2002). This model adopts a cyclical structure in which students move from engagement with a topic and the formulation of research questions to identifying relevant knowledge, collecting data, synthesizing and presenting outcomes, and evaluating the process (Figure 3). Within this cycle, self-reflection is a core component that supports progress and shapes learning outcomes. Building on this cyclical logic, Ai et al. (2008) articulated IBL through four interrelated components (inquiry, investigation/reflection, evaluation, and construction). Levy et al. (2010) shifted attention to agency and guidance, emphasizing that inquiry can begin with a question, theme, or problem, and is completed through the sharing of outcomes in assessable forms (for example, presentations, reports, critiques). Bacon and Matthews (2014) extend these accounts by framing instructors and learners as

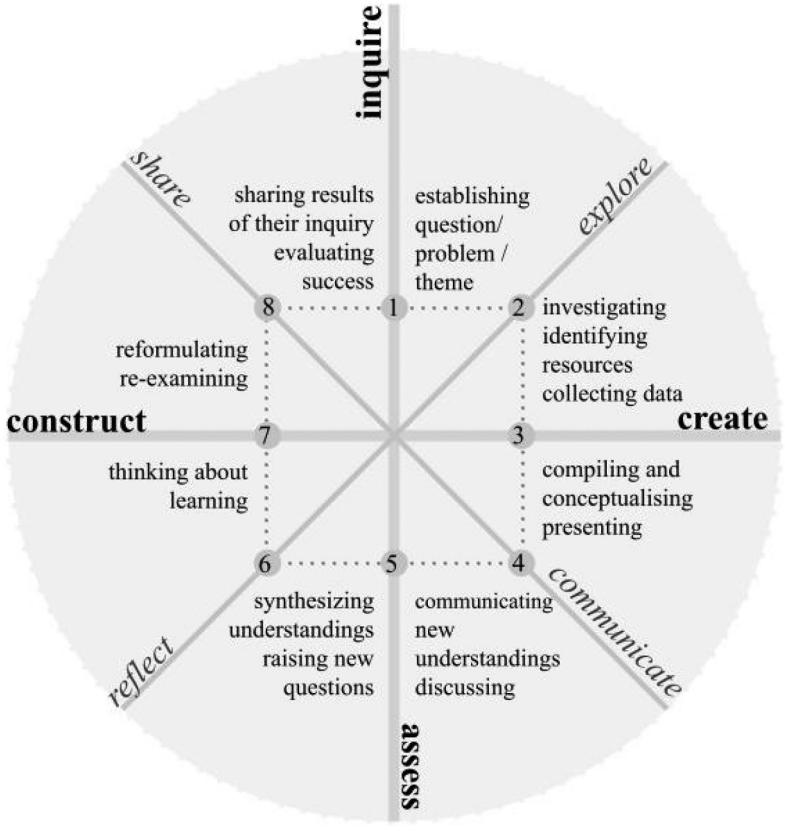

Figure 3. IBL cycle, adapted from Justice et al. (2002) and Ai et al. (2008), illustrated by the author.

collaborative actors across the stages of connection, inquiry, presentation, reflection, and action.

Collectively, these models foreground a point that is especially relevant to studio pedagogy: IBL is scalable and configurable, rather than fixed. Levy et al. (2010) distinguished between inquiry oriented toward exploring existing knowledge and inquiry aimed at producing new knowledge, positioning students as both investigators and intellectual contributors. Similarly, Spronken-Smith et al. (2012) demonstrate that IBL can be designed as structured, guided, or open, and framed as information-oriented or discovery-led, depending on the learning context. This flexibility provides a conceptual basis for adapting inquiry design to the temporal rhythms, representational practices, and assessment cultures of architectural-design studios.

A widely used operationalization of this flexibility is the IBL matrix developed by the Center for IBL in the Arts and Social Sciences (CILASS) at the University of Sheffield, UK. The matrix maps inquiry along three dimensions: inquiry for learning versus inquiry for knowledge building (vertical axis), who defines the inquiry theme (horizontal axis), and the degree of instructional support (horizontal axis). Within this scheme, four ideal types were identified: *authoring, producing, pursuing, and identifying* (Figure 4). Authoring involves generating one's own open-ended questions, producing responses to questions framed by others, pursuing self-generated lines of inquiry through active exploration, and identifying involves searching for knowledge in response to instructor-defined prompts. As a pedagogical scaffold, the matrix supports a gradual shift toward more independent and discovery-oriented inquiries.

Therefore, designing IBL extends beyond content selection to include the specification of task sequencing, resource provision, spatial and technological support, and the structuring of mentoring and peer interaction, alongside assessment and dissemination strategies (Levy et al. 2010). Recent work in studio-based learning similarly underscores that the ways in which outcomes are assessed and communicated (e.g., critique formats, rubrics, peer feedback) strongly shape students' inquiry trajectories and what they perceive as "valued knowledge" within the studio (Abdellatif and El-Wakeel 2025). Prior research further links participation in IBL-oriented activities with intellectual development and scientific literacy (Hu, Kuh, and Li 2008) and highlights its contribution to transferable capacities such as problem-solving, inquiry, and self-regulation. This is needed to address ill-defined problems and translate learning across contexts (Branch and Solowan 2003).

2.3. Integrating IBL into architectural education

An increasing body of research positions IBL as a productive approach to architectural education, particularly within design studios, where inquiry can be coupled with both individual and collaborative

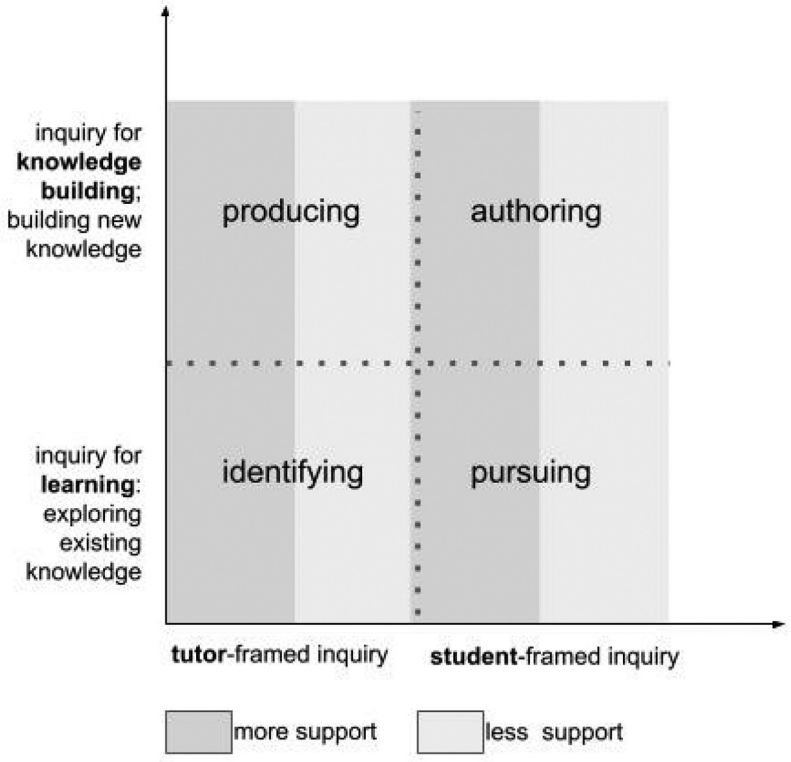

Figure 4. Modes of IBL (Levy et al. 2010).

learning. This dimension of architectural education holds significant potential for transforming traditional learning patterns (Carnell 2017). Eigbeonan (2013) argues that design teaching should be conceptualized as a continuous process of inquiry, emphasizing that such a process enhances students' capacity to address environmental challenges while simultaneously fostering their creativity and commitment. More recent studio scholarship aligns with high-impact learning principles by demonstrating how authentic, externally situated tasks, such as community-engaged briefs and collaborative, real-world partnerships, extend inquiry beyond the classroom and strengthen students' technical and interpersonal skill development (Mazlan et al. 2025; Salama and Patil 2025).

Despite its growing adoption, IBL remains difficult to implement consistently in a studio context. Several studies have emphasized the need to clearly specify instructor roles and forms of guidance. Dobber et al. (2017) categorized instructional strategies in relation to levels of guidance (teacher-centered, student-centered, and hybrid) and types of regulation (metacognitive, conceptual, and social), highlighting that inquiry requires not only content delivery but also structured support for reflective thinking, meaning-making, and collaboration. In parallel, Yildirim Tschoepe (2014) frames IBL as a pedagogical shift away from hierarchical teacher-student relations toward learning that prioritizes comprehension and critical reflection over the passive accumulation of knowledge. Recent studio-based assessment research reinforces that feedback and evaluation practices are not neutral "end stages." Rather, self- and peer-assessment can strengthen metacognition and accountability, clarify assessment criteria, and improve students' preparation for jury and critique situations, thereby shaping inquiry trajectories throughout the semester (Doheim 2025). Related work on critique culture further argues that traditional critique formats may be experienced as intimidating and not always conducive to learning, motivating the development of more interactive and discussion-oriented critique typologies that better support sustainable learning and assessment in studio settings (Ezennia and Agbonome 2025).

Two complementary frameworks help operationalize inquiry in studio design education. First, Banchi and Bell's (2008) inquiry continuum clarifies how inquiry can be staged through varying degrees of scaffolding, ranging from confirmation and structured inquiry to guided and open inquiry, thereby supporting the intentional calibration of autonomy and responsibility across the studio tasks. Open and discovery-oriented forms are often associated with a stronger learning impact (Spronken-Smith et al. 2012). Second, the universal design for learning framework emphasizes learner diversity and proposes flexible teaching through multiple means of representation, action and expression, and engagement. These are the principles that align with studio cultures in which students' motivations and self-regulation capacities vary (Yildirim Tschoepe 2014).

Overall, these studies suggest that integrating active learning and high-impact practices into architectural design studios depends on an aligned ecology of tasks, guidance, peer interaction, and assessment and dissemination practices. Accordingly, this study approaches the architectural design studio as an empirical site of inquiry and examines how its pedagogical conditions enable or constrain inquiry-oriented learning.

3. Architectural studio as a site of inquiry: fieldwork and empirical insights

The Faculty of Architecture at Yildiz Technical University in Türkiye has continuously revised its undergraduate curriculum in response to national and international accreditation goals, supported by self-assessment and educational workshops. Outcomes from recent workshops have repeatedly emphasized the need to strengthen research-based approaches in design studios, expand opportunities for theoretical debate, adapt scientific research practices to the undergraduate level, and enhance student motivation through thematic and conceptual frameworks. In response to these institutional discussions, this study focuses on AD4, a prerequisite core studio in the undergraduate curriculum. AD4 provides a pedagogical setting in which students are expected to develop contextual and sustainability-oriented design proposals through research, analysis, synthesis, and conceptual production within an integrated design framework. The studio runs eight hours per week, is structured around two midterm juries and a final jury and evaluates students through a combination of oral and written components, considering project development, conceptual reasoning, research depth, and representational skills. In addition to jury performance, active participation and progress over the semester constitute key assessment criteria, making AD4 a particularly relevant case for examining how inquiry is scaffolded, communicated and evaluated in studio culture.

3.1. Design of the survey

The survey instrument was designed by adapting the IBL Planner Template proposed by Levy et al. (2010) as an organizational framework. In this template, inquiry design is structured around four interrelated elements (students, intended learning outcomes, inquiry theme, and inquiry process) and operationalized through five studio-relevant components: (1) tasks and sequencing,

(2) access to and production of information, (3) spaces and technologies, (4) tutoring and peer interaction, and (5) assessment and dissemination. Building on these foundations and the study's conceptual framework, a survey was developed to examine the specific practices of the AD4 studio and to identify potential areas for pedagogical transformation. Survey items were constructed by systematically aligning a *diagnosis-proposition* structure with the IBL Planner Template and subsequently refining the wording for clarity and consistency across the educator and learner versions. The instrument included Likert-type rating scales and multiple-choice questions, complemented by a limited number of open-ended prompts used to deepen the interpretation where necessary. Open-ended responses were analyzed and summarized as recurring patterns related to the IBL components. The survey was administered to both studio instructors ($n = 28$) who had previously coordinated AD4 and students ($n = 54$) who had experienced the studio. Participants were recruited on a voluntary basis from those with direct experience of AD4, aiming to capture varied student experiences and long-term instructor perspectives. Written informed consent was obtained from all participants. Background information on educators, including their academic titles, responsibilities, duration of studio teaching, and professional practice, as well as learners' educational and career plans, is presented in Table 1.

The survey followed similar thematic orientations for both participant groups; however, the item wording was adapted to reflect the distinct positions of educators and learners. Its design aimed to capture participants' evaluations of the current state of studio practices and elicit their proposals for a pedagogical reframing of IBL. Therefore, the instrument was structured in two parts (Figure 5). The first part, "Diagnosis: Critique of current state" presents participants' reflections on the strengths and weaknesses of existing practices as experienced through the five studio-operational IBL components:

(1) In inquiry-based curriculum development, a core approach involves planning process-oriented tasks that support procedural skills such as orienting to IBL, formulating research questions, selecting methods of inquiry, developing information literacy, and engaging in reflective thinking. Accordingly, the survey items addressed the weekly studio program, student attendance, and task-based learning practices to assess their impact on the student experience.
(2) Since IBL entails decisions about when, how much, and through which means knowledge is provided or generated, items examined the balance between ready-made information and inquiry-derived knowledge, including the perceived alignment between theory-practice integration and course learning outcomes.
(3) Drawing on discussions of IBL learning spaces, items examined the use of physical studio space and digital technologies that enable interaction, access to knowledge, experimentation, and the production and sharing of inquiry outcomes.
(4) Since IBL reshapes classroom power relations by positioning educators less as authorities and more as facilitators, guides, resource providers, or collaborators, items examined educator-learner relations, role expectations, and

Table 1. Profiles of educators and learners.

educators	s	%	learners	s	%
Title			Educational status		
Research Assistant.	10	35.7	Over 3 years, 4th year students	21	38.8
Research Assistant (PhD)	2	7.1	Over 4 years	28	51.9
Lecturer	7	25	Graduate	5	9.3
Lecturer (PhD)	3	10.7	Self-description		
Associate Professor	3	10.7	Purposeful, motivated learner	24	44.4
Professor	3	10.7	Skilled and knowledgeable learner	13	24.1
Years of academic service			Strategic, goal-oriented learner	17	31.5
0–5 years	10	35.7	Career plans		
6–10 years	12	42.9	Professional practice	30	55.6
11 years and above	6	21.4	Academic career	13	24.2
Years of studio instruction			Both	8	14.8
0–5 years	16	57.1	Undecided	3	5.5
6–10 years	7	25			
11 years and above	5	17.9			
Years of professional practice					
Less than 1 year	5	17.9			
1–5 years	11	39.3			
6–10 years	3	10.7			
11 years and above	7	25			
None	2	7.1			
Years of pedagogical training (if any)					
None	21	75			
Within graduate education (pedagogical formation)	4	14.3			
Short-term training or certified programs	3	10.7			

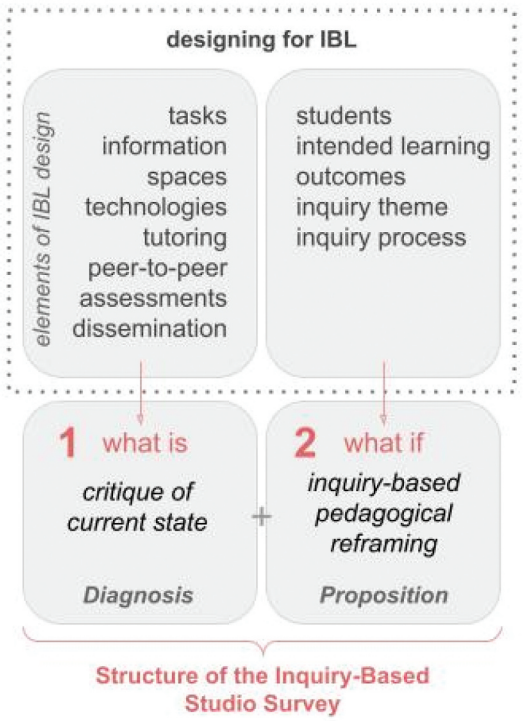

Figure 5. Framework of the inquiry-oriented survey design.

experiences of group work and peer collaboration. Informed by CILASS discussions that identified group work as a recurrent challenge for learners, the survey also probed the perceived usefulness of structured supports such as group contracts (for example, role allocation, communication frequency, participation responsibilities) and process-oriented interim check-ins.

(5) Aligning assessment with IBL outcomes implies evaluating not only design outputs but also inquiry processes. Accordingly, items addressed the jury system, transparency of assessment criteria, and remedial mechanisms, as well as process-sensitive practices (for example, co-defined criteria and peer and self-assessment). Multiple-choice items also captured preferences regarding assessment tools and modes of disseminating inquiry outputs beyond the studio cohort.

The second part, "proposition: inquiry-based pedagogical reframing" elicited participants' suggestions on how studio environments and processes might be reconfigured within an IBL framework. Drawing on Levy et al. (2010), the analysis is organized around four key elements: (a) students, (b) learning outcomes, (c) inquiry themes, and (d) inquiry processes. Each element was assessed for its transformative potential.

(a) The IBL process is shaped by students' prior disciplinary knowledge and skills, and their understanding of inquiry itself. This element addressed what students brought to the inquiry, how they conceptualized research, and how they positioned themselves as student-researchers. It also considers how beliefs about knowledge production, expectations of teaching-learning relations, self-confidence, and perceived capabilities may pose challenges in IBL contexts. Accordingly, the survey examined the types of support and guidance that students might require in relation to both disciplinary content and the inquiry process.

(b) This element addresses fundamental pedagogical questions concerning whether learning should prioritize engagement with existing knowledge or the generation of new ideas, how to balance content knowledge with process-based competencies, and to what extent students should participate in co-defining intended learning outcomes. These considerations shape the pedagogical framing of design studios.

(c) Questions in this category focused on how inquiry-based processes might be structured to strengthen student engagement and participation, including what students are encouraged to explore and how inquiry aligns with the curriculum. This element also examined who defines inquiry questions (students or educators), whether student inquiries should connect to faculty research agendas, and how such links should be articulated.

(d) The proposed suggestions further concern the scale, duration, and structure of inquiry processes: whether inquiry should be predefined by the instructor or co-developed flexibly with students; how much agency students have in shaping their approach; and whether prescribed methods align with disciplinary research practices.

3.2. Findings

The survey provided a systematic means of collecting quantitative data while enabling in-depth qualitative insights through open-ended questions. Responses from the student survey offered a holistic perspective on how pedagogical approaches and values were interpreted through the lens of the student experience. While instructors' contributions revealed aims and expectations that were not always made explicit in the curriculum, learners' responses enhanced the visibility of learning outcomes and values as they were experienced. The following sections present and interpret the findings thematically under the two headings: diagnosis and proposition.

3.2.1. Diagnosis: critique of the current state

3.2.1.1. Tasks. The findings on the weekly scheduling of the studio revealed divergent approaches among educators. A plurality of participants (42.9%; $n = 12$) reported flexibly updating their weekly schedules in response to student progress. Another 39.3% ($n = 11$) indicated adherence to the official studio schedule. A smaller proportion (17.9%; $n = 5$) stated that they established a predefined, fixed schedule at the beginning of the semester and required students to comply. Notably, no educator selected the options "student-led planning with low adherence" or "student-led planning with partial adherence." Student responses to the question "Which type of scheduling best reflects your studio experience"? presented a somewhat different picture. The majority (61.1%; $n = 33$) indicated that the schedule was shaped primarily by the weekly directions of their studio instructor. Other responses included students preparing their own schedules but adhering to them only partially (16.7%; $n = 9$), mostly failing to follow them (13.0%; $n = 7$), or attempting to comply with the official timetable (9.3%; $n = 5$) (Figure 6). Considered jointly, these patterns suggest an asymmetry between educators' perceived flexibility and learners' experience of instructor-led pacing, indicating that "adaptivity" may not always be legible to students as a shared plan.

Educators most frequently rated the time allocated as sufficient for analysis-synthesis studies (70%) and for jury evaluations (70%). In contrast, sufficiency was lower for three-dimensional productions (56%) and lowest for system detail drawings (46%), indicating that technical detailing was perceived as the most time-constrained component from the educator's perspective. Student responses showed a broadly similar ordering but sharper contrasts: research (80%), analysis – synthesis studies (80%), and individual desk critiques (78%) were most often rated as sufficient, whereas system detail drawings received the lowest sufficiency rating (30%), followed by three-dimensional

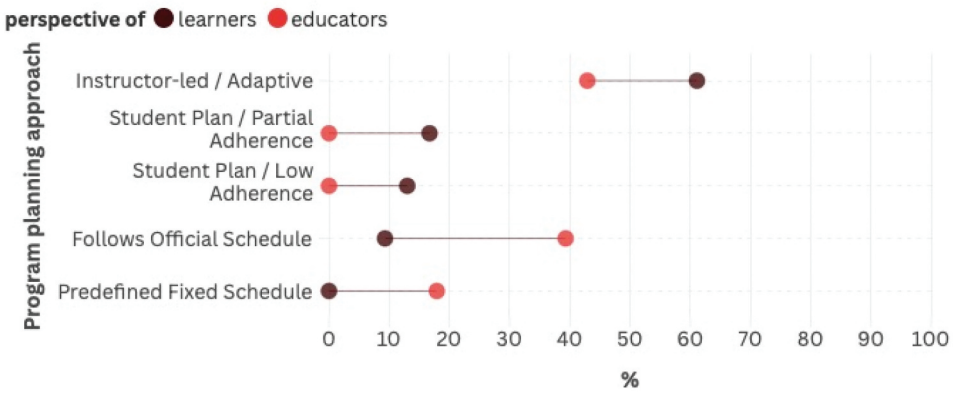

Figure 6. Program planning approach from the perspective of learners and educators.

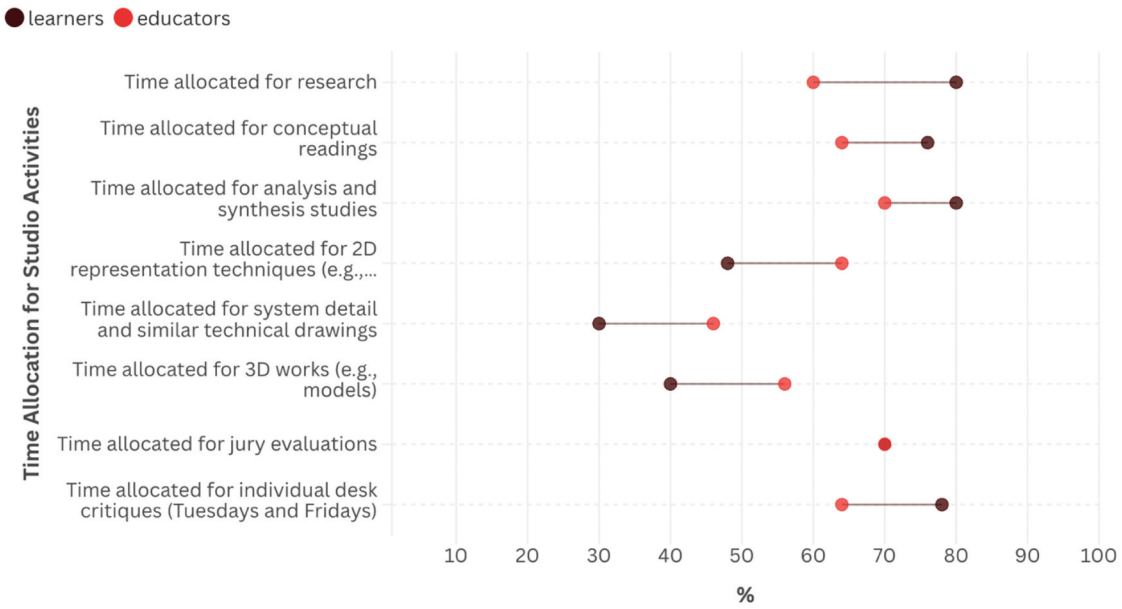

Figure 7. Percentage of educators and learners who rated the time allocated to each studio activity as sufficient.

modeling (40%) and two-dimensional representation techniques (48%) (Figure 7). Taken together, both groups converge on the view that conceptual and inquiry-oriented phases are better accommodated than technical detailing and representational or production requirements, with system detailing emerging as the most time-pressured activity.

Seventy-five percent of the instructors ($n = 21$) indicated that students struggled the most in generating conceptual ideas. This was followed by difficulties in developing critical thinking and synthesizing analyses (64.3%, $n = 18$), sustaining model production (53.6%, $n = 15$), and maintaining their motivation (50%, $n = 14$). Less frequently reported challenges included engaging in theoretical discussions (46.4%, $n = 13$), improving projects in line with critiques (32.1%, $n = 9$), progressing through research (32.1%, $n = 9$), actively participating in class (17.9%, $n = 5$), and completing drawings (17.9%, $n = 5$). A very small number of participants highlighted issues such as written expression, group work, and developing abstract thinking, each reported by only one respondent (3.6%, $n = 1$). Overall, educators framed the major bottleneck primarily at the level of concept generation and synthesis, with production-related issues appearing as secondary but still significant constraints.

Student responses to the question "in which tasks and situations do you most frequently experience difficulties in the studio?" based on a five-point Likert scale) identified model-making and sustaining this work throughout the semester (62%) and completing drawings on time (60%) as the most prominent challenges. In contrast, lower frequencies were reported for advancing through research (40%), developing a critical perspective (46%), expressing ideas in writing (48%), and active class participation (48%) (Figure 8). Compared with educators' emphasis on ideation and synthesis, learners' reported difficulties appear more closely tied to representational workload and timing, suggesting that production pressures may shape how inquiry is sustained in practice.

3.2.1.2. Information. Among educators, the ability to "integrate experiential knowledge with conceptual knowledge rather than relying on definitive information" was rated as partially sufficient by 17 participants and sufficient by 11, reaching an overall adequacy level of 80 %. The competence of "understanding and interpreting theoretical relationships" was considered partially sufficient by 15 respondents, sufficient by 11, and inadequate by 2. Similarly, the item "encouraging relational thinking and generating new ideas open to inquiry" was assessed as sufficient by 15 participants, partially sufficient by 11, and inadequate by 2. Taken together, educators perceived students as relatively capable of working conceptually while identifying more uneven performance in consistently constructing theory-informed or relational arguments. In response to the question "What are your views on knowledge and skill acquisition in AD4 studios?" students' answers

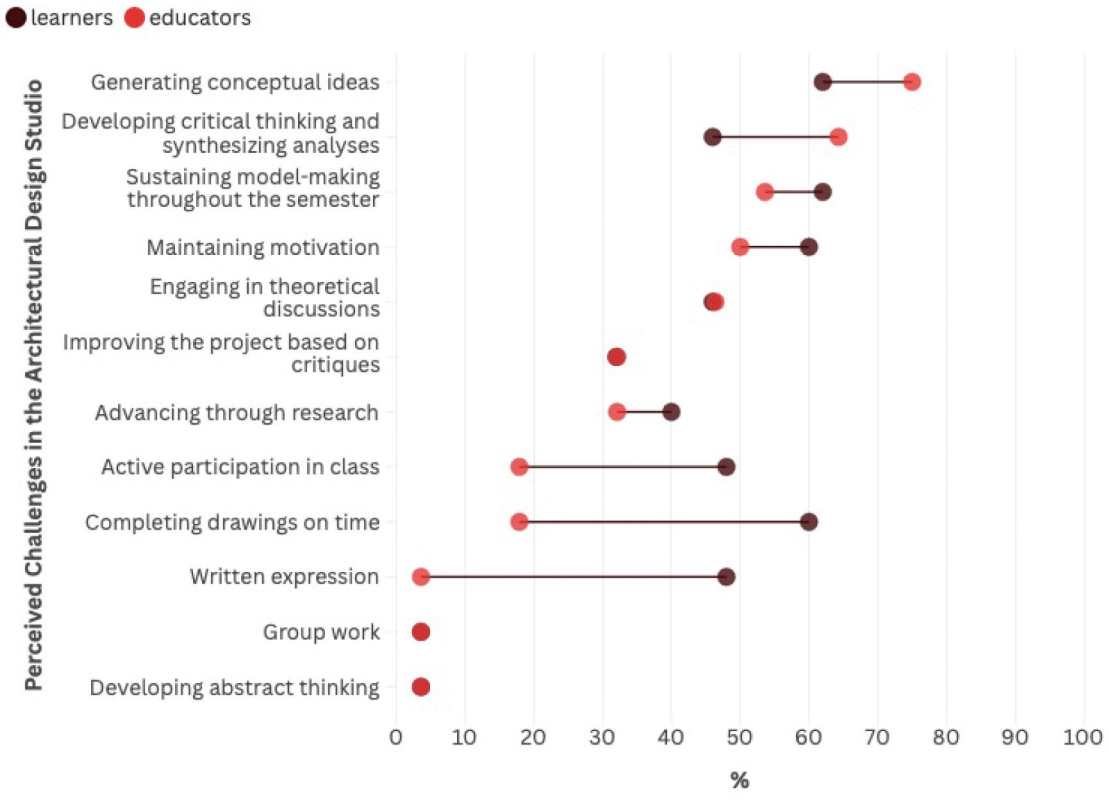

Figure 8. Perceived challenges in the studio.

revealed varied levels of experience and understanding. A total of 42.6% ($n = 23$) agreed with the statement "I was encouraged to think relationally and to generate new ideas open to inquiry." This was followed by 27.8% ($n = 15$) who reported having "improved their ability to understand and interpret theoretical relationships," and 24.1% ($n = 13$) who stated that they had "integrated experiential knowledge with conceptual knowledge instead of relying on definitive facts." This dispersion suggests that inquiry-related gains may not be uniformly experienced across the cohort.

When asked about the transfer of theoretical content into the design studio, 19 educators (67.9%) reported that students "partially" integrated such knowledge, 5 (17.9%) stated that students did not integrate it, and only 2 (7.1%) noted that students effectively transferred their theoretical knowledge. Two participants (7.1%) did not respond. Student responses to a parallel question indicated a similar pattern: the majority (63%, $n = 34$) reported being able to use theoretical knowledge "partially," while 35.2% ($n = 19$) stated that they could use it directly, and only one student (1.9%) reported being unable to apply theoretical content. These findings suggest that theoretical and applied components are only partially integrated, and that the link between them requires further strengthening. Across both groups, "partial use" emerged as the dominant pattern, indicating that while the theory-studio link remained present, it would benefit from clearer scaffolding and more explicit integration points.

Among educators, the most highly rated learning gains were "encouragement to conduct research through thematic topics" and "providing an environment open to critical thinking," both evaluated at 76% ($n = 21$). These were followed by "making sense of real-world problems" (71%, $n = 20$) and "encouragement to develop sustainable solutions" (68%, $n = 19$). In contrast, "integration of theoretical knowledge into studio projects" (60%, $n = 17$) and "preparation for professional practice" (54%, $n = 15$) were assessed as relatively less adequate. This reflects a perception that while inquiry-related competencies are sufficiently supported, theoretical integration and professional readiness remain weaker dimensions. From the perspective of students, the most highly valued learning outcomes were similarly "encouragement to research through thematic topics" (72%) and "provision of an environment open to critical thinking" (70%), followed by "development of inquiry skills" (70%) and "encouragement to produce sustainable solutions" (70%). Lower ratings were given to the studio's "capacity to prepare for professional practice" (52%) and "opportunities for theoretical discussion" (60%) (Figure 9). The convergence between educator and learner rankings strengthens the interpretation that inquiry-oriented gains are salient, whereas theoretical articulation and professional readiness are perceived as comparatively less supported.

3.2.1.3. Spaces and technologies. Open-ended responses revealed that educators primarily pointed to inadequate physical space, large student cohorts, lack of student motivation, divergences in instructors' perspectives, and difficulties in students' time and process management as critical challenges. Students, in contrast, emphasized insufficient time allocated for inquiry, a premature shift from research to technical production, information overload complicating process management, lack of egalitarian attitudes, overcrowded studios, inadequate physical conditions, and the absence of constructive feedback.

The most pronounced shortcomings among studio instructors were limited mastery of digital

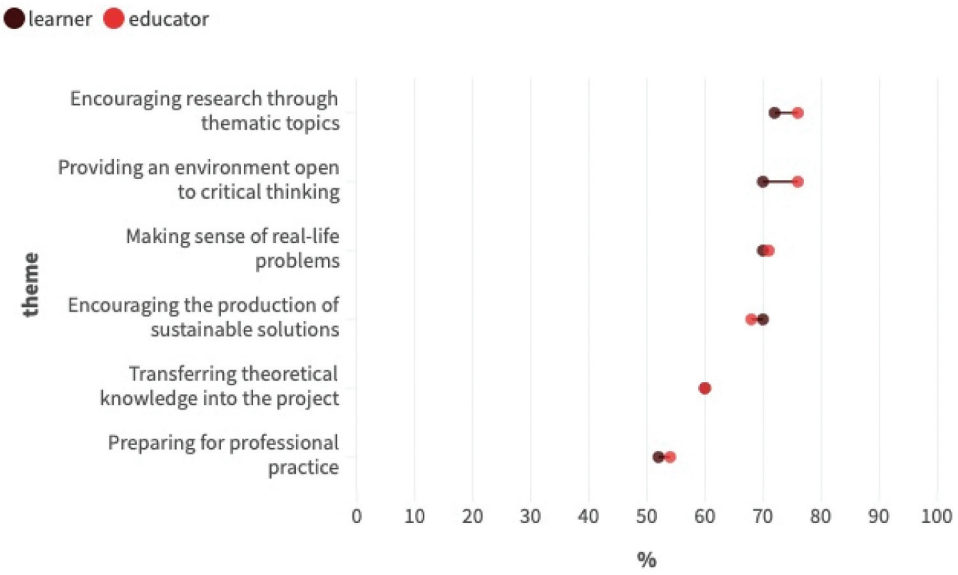

Figure 9. Knowledge acquisition and inquiry skills.

technologies (39.3%, $n = 11$) and ineffective communication with students (21.4%, $n = 6$). Additional limitations were noted in critical thinking, curiosity-driven guidance, problem-solving, research and presentation skills, and awareness of contemporary projects (17.9%, $n = 5$). Less frequently mentioned were egalitarian attitudes toward students (14.3%, $n = 4$), the ability to guide access to information sources (10.7%, $n = 3$), and directing students to alternative resources (7.1%, $n = 2$). The prominence of "digital mastery" suggests that technological fluency is perceived as a prerequisite for supporting inquiry processes.

Students were asked to select at least three items related to instructors' deficiencies. The most frequently identified shortcomings were inadequate mastery of digital technologies (57.4%) and lack of egalitarian attitudes toward students. These were followed by limited ability to guide access to information sources (40.7%), insufficient communication skills (38.9%), and lack of encouragement for curiosity, critical thinking, and problem-solving (35.2%). Less frequently noted issues included insufficient awareness of contemporary projects (20.4%), lack of research and presentation guidance (18.5%), and inadequate feedback on technical drawing details (11.1%). In addition, 22 students selected "no opinion," while 15 used the "other" option to highlight concerns such as insufficient explanation of studio objectives, difficulty in keeping up with the schedule, lack of support for alternative approaches, and inadequate feedback on technical details.

3.2.1.4. Tutoring and peer-to-peer interaction. Among the educators, the majority (60.7%, $n = 17$) emphasized that the instructor – student relationship in the architectural design studio should be structured as the instructor as a guide and the student as a responsible learner. This was followed by a model in which an experienced and an inexperienced participant jointly explored knowledge (28.6%, $n = 8$). The master – apprentice learning model was endorsed by only 7.1% ($n = 2$), while collaborative and mutually open learning interactions received the lowest support (3.6%, $n = 1$). Students similarly prioritized the instructor as a guide – student as a responsible learner model (46.3%, $n = 25$), followed by the experienced-inexperienced pair jointly exploring knowledge (27.8%, $n = 15$). In contrast, 25.9% ($n = 14$) continued to favor the master-apprentice learning model. These findings suggest that while students largely value guidance-based, autonomy-oriented models of interaction, a substantial minority continues to perceive the traditional apprenticeship paradigm as relevant (Figure 10). This division is pedagogically consequential because it may shape how learners interpret authority, feedback, and responsibility within an inquiry-oriented studio.

Regarding group work, the students highlighted several problematic aspects. The most frequently reported challenge was unclear role allocation (81.5%). This was followed by perceptions of unfair workload distribution (61.1%). Only two students (3.7%) reported consistently positive group work experiences. Overall, these findings underscore that ambiguity in role assignments and imbalances in workload sharing remain critical issues for learners in collaborative settings. Taken together, these patterns indicate a need for structured collaboration scaffolds, such as defined roles, interim checkpoints, and shared assessment criteria), if group work is to function as an inquiry-support mechanism rather than a coordination burden.

3.2.1.5. Assessments and dissemination. Among educators, 53.6% ($n = 15$) agreed that analyses, research, and technical drawings should be graded separately and that their weight in the final grade should be shared with students, while 46.4% ($n = 13$) disagreed. The most frequently cited components to be included in the final grade were studio critiques (67.9%, $n = 19$), interim juries (64.3%, $n = 18$), and

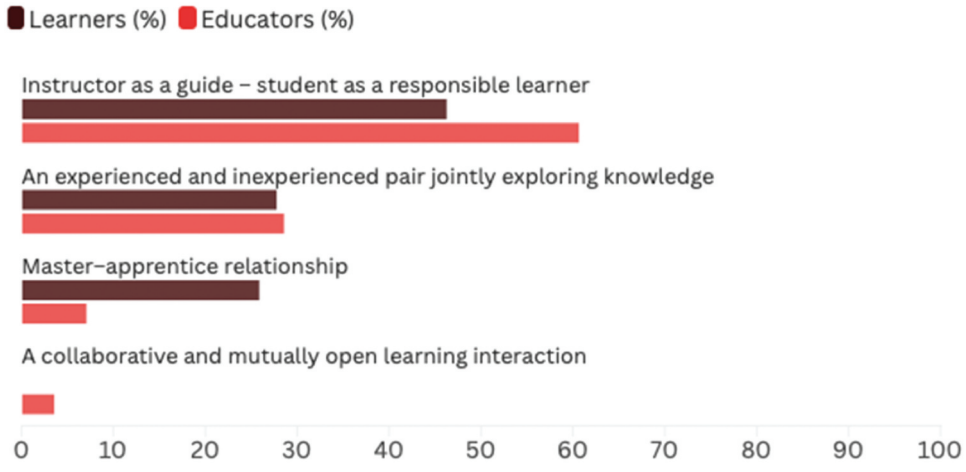

Figure 10. Instructor–learner relationship models.

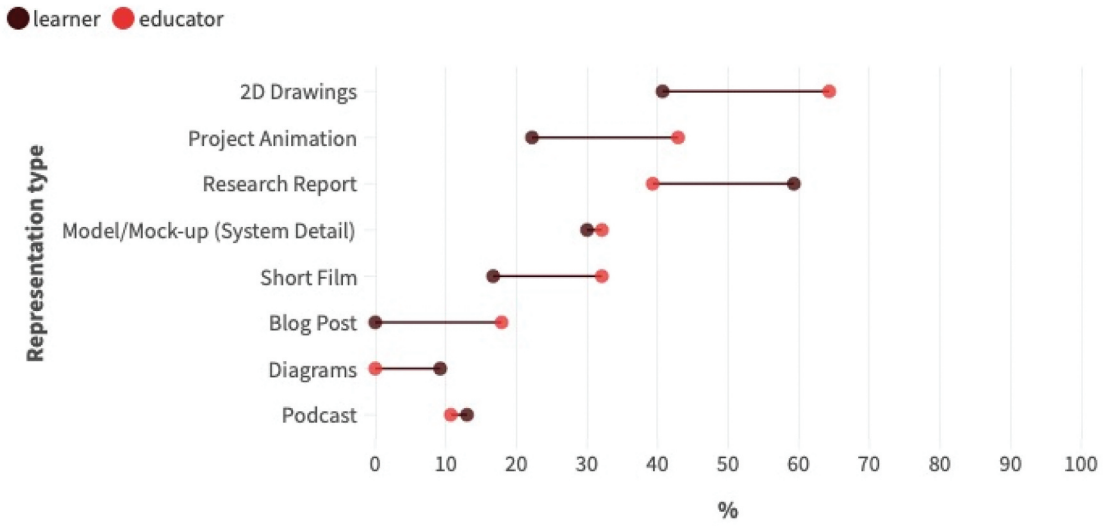

Figure 11. Representation of research outputs.

attendance and participation (46.4%, $n = 13$). These were followed by workshops and seminars (39.3%, $n = 11$), assignments (35.7%, $n = 10$), and fieldwork (25%, $n = 7$). Only one respondent (3.6%, $n = 1$) referred to "approach to the subject and final product" (3.6%, $n = 1$) as a grading criterion. In contrast, student expectations revealed a stronger demand for assessment transparency: 64.8% ($n = 35$) supported the separate grading of analyses, research, and technical drawings with explicitly stated weightings, whereas 35.2% ($n = 19$) did not. Taken together, both groups recognized assessment transparency as a key issue, although students expressed a stronger preference for explicitly articulated weights and criteria.

All educators rejected the idea of a make-up exam for the design studio, emphasizing that assessment should encompass not only the final product but also the process leading to it. They argued that make-up exams undermine the significance of final evaluations, that the 14-week studio schedule is sufficient, and that effective time management should be a pedagogical outcome. Some educators suggested summer school or alternative grading adjustments. In contrast, nearly all students (except two) supported the introduction of a make-up exam. Their justifications pointed to the intensity of final week examinations, insufficient time to consolidate critiques, and unforeseen circumstances that may have prevented participation. Students also viewed make-up exams as a means to prevent semester loss, ensure fairness, and address deficiencies. A minority emphasized the need for greater transparency in assessments. The two students opposing make-up exams argued that design studios should be evaluated solely through the final review and that a project not completed within the semester could not be meaningfully redeemed through a make-up assessment. This divergence suggests that educators and learners operate with different logics of fairness: an emphasis on process continuity and sustained engagement on the one hand, and sensitivity to workload peaks and unforeseen contingencies on the other.

Educators most frequently selected 2D drawings (64.3%, $n = 18$), project animations (42.9%, $n = 12$), and research reports (39.3%, $n = 11$) as their preferred modes of representation. These were followed by detailed models or prototypes (32.1%, $n = 9$), short films (32.1%, $n = 9$), blog posts (17.9%, $n = 5$), and podcasts (10.7%, $n = 3$). These findings indicate a preference for multimodal representation, in which visual and textual media are combined to support inquiry processes initiated through open-ended questions or problem-based scenarios. Open-ended responses revealed two main perspectives. One emphasized the importance of using diverse representational tools to foster distinct skills, while the other stressed the necessity of retaining conventional modes of architectural representation. In this context, 2D and 3D drawings, animations, detailed models, and films were valued for their contributions to idea development, scenario visualization, digital fluency, and drawing proficiency. Podcasts and Reports were viewed as complementary tools that enable the integration of visual and written media, whereas blogs were considered particularly valuable for documenting processes and supporting personal reflection (Figure 11).

3.2.2. Proposition: inquiry-based pedagogical reframing

3.2.2.1. Students. Students were asked to evaluate the qualities gained through the AD4 studio structure in relation to critical thinking, communication, research and design. The highest scores were reported for critical thinking (80%) and research (80%), while design, understood as the ability to creatively regenerate design knowledge and produce original

outcomes in line with universal principles, received comparatively lower evaluations (70%). This suggests that students perceived strong cognitive and research-related development but identified a greater need for support in translating these skills into the design outcomes.

When students' perceived competencies were examined through an IBL lens, the highest levels of confidence were reported in information searching (80%), followed by self-assessment (70%), goal setting (68%), decision making and implementation (64%), and planning (60%). This distribution indicates that students feel more competent in individual learning skills related to research and reflection while requiring greater support in planning and application processes.

In response to the open-ended question, "if you had the authority to change one thing in the architectural design studio, what would it be?", students most frequently criticized the excessive number of deliverables required for the final submission. Several respondents stated that certain tasks were perceived as "obligatory" rather than pedagogically necessary and should therefore be removed. Illustrative comments included: "removing the obligation for continuous desk critiques," "eliminating the requirement for enclosed spaces," "omitting technical drawings that disrupt the research and conceptual design process," "shortening the repetitive analysis phase that delays actual design development," "excluding partial system detail requirements," "removing model-making obligations," and "reducing the number and representational constraints of final deliverables." These views primarily reflect students' critiques of the analysis-synthesis-evaluation cycle in AD4. They frequently noted that the prolonged analysis phase hindered the timely development of conceptual outcomes and led to premature engagement with 2D representation tools. Students also proposed several operational improvements: reducing group sizes, organizing studios as functional ateliers, increasing digital literacy and the use of design software, integrating extracurricular events with practicing architects, fostering open communication with instructors, ensuring transparency in grading criteria, and addressing collective student concerns. Collectively, these suggestions point to a desire for a more flexible, participatory, and productive studio experience that better aligns pedagogical intent with structural conditions.

3.2.2.2. Intended learning outcomes. To identify where the studio process should primarily focus, students were asked to position their research experiences along two dimensions of inquiry: inquiry for learning and inquiry for knowledge-building. A substantial majority (85.7%, $n = 24$) favored the open-ended approach of constructing new knowledge, while only 14.3% ($n = 4$) preferred inquiry, oriented toward acquiring existing knowledge. Students' experiences were further analyzed using the four ideal IBL types: identifying, pursuing, producing, and authoring. The findings indicate that students most frequently align with authoring and pursuing modes, suggesting a strong inclination to generate questions and produce them through self-directed exploration. Conversely, producing and identifying modes where inquiries were primarily framed by instructors were less common. Overall, the students demonstrated a clear tendency toward learner-centered inquiry aimed at knowledge construction.

When asked about the purpose of research within the studio, students identified conceptual or thematic exploration, learning from precedents, investigation of system details and materials, and the discovery of site-specific problems. These responses suggest that students' structure their research to support both conceptual development and practical design decision-making. Regarding student participation in defining learning outcomes, 64.3% ($n = 18$) of the instructors supported the idea, while 35.7% ($n = 10$) opposed it. Supporters emphasized that student involvement fosters responsibility, allows flexibility and renewal of learning outcomes across cohorts, and makes implicit learning achievements more visible. Opponents expressed concerns regarding organizational complexity and students' limited motivation, awareness, and preparedness. Instructors also proposed strategies to foster critical thinking, including integrating other artistic disciplines, organizing guided reading and research sessions, facilitating spatial experiences and "thinking aloud" practices, introducing contemporary social dynamics into discussions, emphasizing the intellectual dimension of architecture, employing tools that bridge theory and practice, creating spaces for free expression, providing pedagogical support, and incorporating peer assessments.

From the students' perspective, the most significant stimuli for developing critical thinking and design ability were direct desk critiques from studio instructors (90.7%), followed by peer discussions (66.7%), jury reviews (53.7%), interdisciplinary interactions (38.9%), and informal consultations with other instructors (31.5%). These findings confirm that students' critical and design thinking are most effectively nurtured through direct, dialogical engagement within the studio environment.

3.2.2.3. Inquiry theme. Among the prerequisites perceived as essential for improving studio performance, the most frequently endorsed were engagement with theoretical readings (57.1%, $n = 16$), development of inquiry skills (57.1%, $n = 16$), and sketch or model studies (53.6%, $n = 15$). These were followed by establishing cause-effect relationships (46.4%, $n = 13$), time management (28.6%, $n = 8$), use

of digital design tools (17.9%, $n = 5$), access to contemporary architectural references (14.3%, $n = 4$), and verbal expression skills (14.3%, $n = 4$). Notably, the respondents did not mention written expressions.

When asked about the difficulties encountered during research, the most common challenge was integrating acquired information into projects (74%). This was followed by uncertainty about what to research (51.8%), lack of access to research resources (38.8%), insufficient time allocation (25.9%), and institutional limitations (16.6%).

Regarding research question formulation, the most frequently endorsed statements were "I sometimes get lost in too much information" (59.2%) and "it helps me focus on the topic I want to explore" (51.9%). The least selected statement was "because my orientation involves interdisciplinary questions, I sometimes cannot find clear answers" (20.3%). These findings suggest the need for stronger guidance in navigating information abundance and filtering knowledge effectively within inquiry-based studio practices.

Instructors evaluated statements concerning the role of research in the studio using a five-point Likert scale. The highest agreement (78%) was recorded for "research should be reviewed, discussed, and linked to experiences with the studio instructor." This was followed by "each stage of the project requires different research levels; the studio schedule should be revised accordingly" (76%) and "research should integrate with real-life experiences and enable learning from real contexts" (74%). Lower levels of agreement were observed for statements such as "research process should be organized as group work, discussed, and evaluated collectively" (60%), "theoretical background should be provided before the research process" (60%), and "research methods should be taught by instructors" (60%). These results indicate that instructors generally perceive research as a process-oriented, experiential, and integral component of studio learning.

Students' views showed a closely aligned pattern. The statement "research should be reviewed, discussed, and linked to experiences with the studio instructor" received the highest agreement (88%), followed by "research should integrate with real-life experiences and enable learning from real contexts," "research should be combined with off-class and off-campus activities for better learning," and "each stage of the project requires different research levels; the studio schedule should be revised accordingly" (all 84%). In contrast, the research process should be organized as group work, discussed, and evaluated collectively" received the lowest agreement (52%). Overall, students appear to value research as an individualized, reflective learning experience that is strengthened through direct engagement with instructors, rather than through collective or prescriptive group structures (Figure 12).

Regarding how instructor-student interaction should be structured within an inquiry-based studio process, 60.7% of instructors ($n = 17$) stated that the process should be conducted under the guidance of the studio instructor. This was followed by those who believed it should be jointly carried out by the instructor and the student (21.4%; $n = 6$), collaboratively undertaken by student groups (10.7%; $n = 3$), and independently conducted by the student (7.1%; $n = 2$).

However, student responses revealed a slightly different hierarchy. The option "it should be carried out jointly with the studio instructor" was most frequently selected (55.6%; $n = 30$), followed by "it should be guided by the studio instructor" (37%; $n = 20$). The options "the student should conduct it individually" (5.6%; $n = 3$) and "student groups should conduct it collaboratively" (1.9%; $n = 1$) received notably lower levels of agreement.

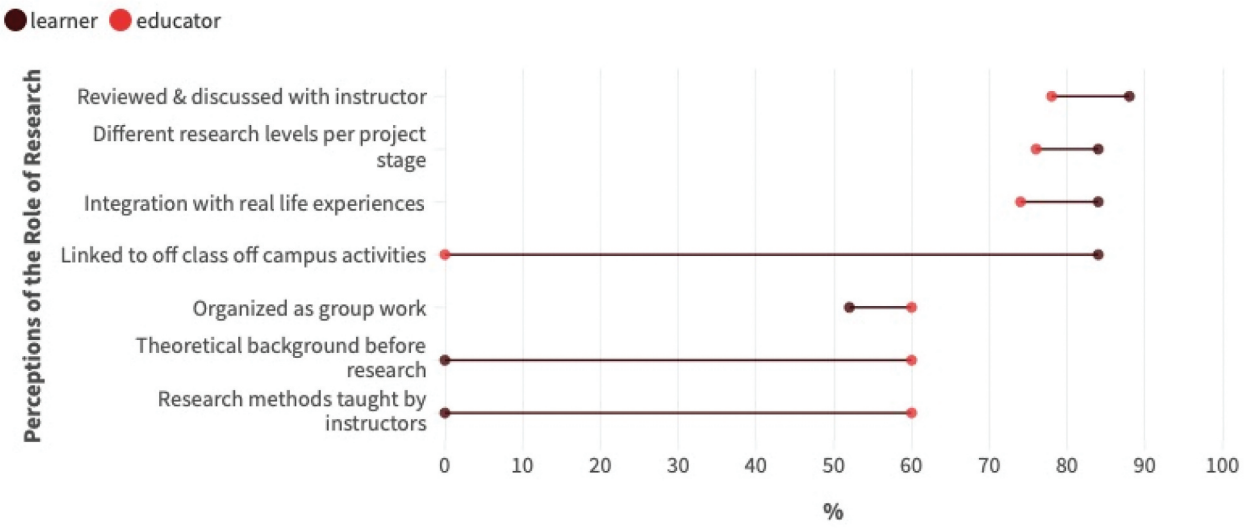

Figure 12. Students' perspectives on the integration of research within the studio.

Overall, these findings suggest that students perceive the research inquiry process as most effective when it involves direct collaboration with the instructor, rather than being conducted independently or collectively.

3.2.2.4. Inquiry process. Findings on how students organized their research processes revealed diverse approaches. Most participants (55.6%; $n = 30$) reported that their research followed planned, organized, replicable steps. Meanwhile, 27.8% ($n = 15$) stated that they conducted only preliminary research without developing a sustained research practice across the semester. The option "my research extends over time but lacks a defined plan" was selected by 12.9% ($n = 7$), while "I only conduct research on topics suggested by the instructor" was the least selected (3.7%; $n = 2$).

In terms of research sources, students most frequently relied on documents shared by instructors, followed by periodicals, architectural books, other university libraries, architectural websites, the university library, and academic publication platforms. This pattern suggests a tendency toward guided and readily accessible sources, reflecting a preference for instructor-mediated materials over autonomous exploration.

Within IBL, the inquiry process is commonly categorized into four levels: confirmation, structured, guided, and open inquiry, which describe how learner autonomy and critical engagement evolve according to the degree of instructional guidance. Survey results indicated that among instructors, structured inquiry was the most preferred level (53.6%; 15 selections), followed by guided inquiry (35.7%; 10 selections). Open inquiry was selected by 25% (7 selections), while confirmation inquiry received the lowest support (3.6%; 1 selection). These findings suggest that instructors favor controlled, yet open-ended inquiry processes that balance pedagogical guidance with student autonomy.

Students' preferences followed a similar pattern. Structured inquiry (42.6%; 23 students) and guided inquiry (40.7%; 22 students) were the most frequently selected, whereas open inquiry (27.8%; 15 students) and confirmation inquiry (3.7%; 2 students) were less common. Overall, these findings indicate that students tend to favor partially instructor-supported models that allow for some self-direction while maintaining pedagogical scaffolding (Figure 13). In response to the question, "which type of stimulus do you think provides the most effective starting point for initiating the inquiry process within the design project?", 39.3% ($n = 11$) selected an open-ended research question, while 25% ($n = 7$) preferred a problem. This was followed by scenarios (17.9%; $n = 5$) and historical data (7.1%; $n = 2$). No participants selected architectural works or performance-based stimuli. This distribution suggests that instructors prioritize forms of initiation that encourage abstract thinking and stimulate inquiry, rather than precedent-driven or performance-led prompts.

4. Results

This section synthesizes the survey responses from educators and learners to provide a comparative reading of current studio practices and inquiry-oriented expectations. Results are presented in two complementary layers: a diagnostic layer, which identifies where the existing studio ecology creates friction for inquiry, and a propositional layer, which consolidates preferred directions for structuring inquiry (guidance, inquiry levels, and assessment

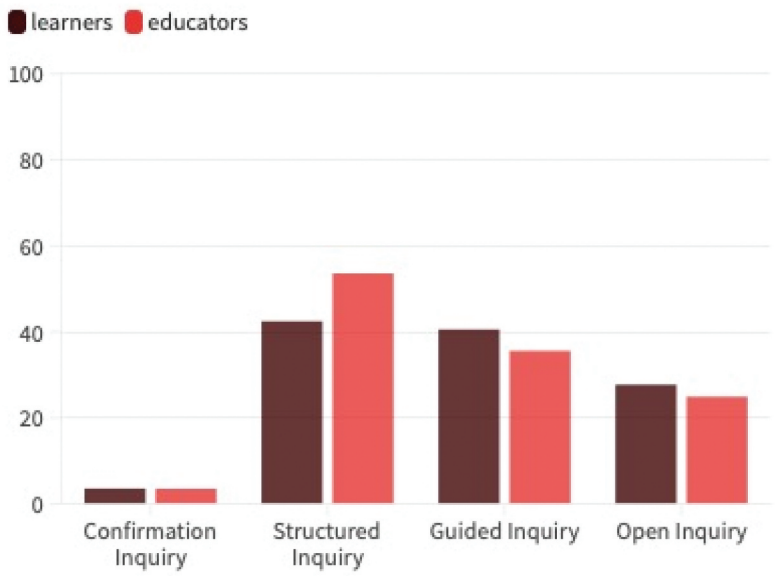

Figure 13. Preferred inquiry levels of instructors and students.

Table 2. Comparison of educators' and learners' views on AD4 studio components.

Studio components	Topics and Indicators	Educator (%)	Learner (%)
Studio schedule	Updating the program according to students' progress	42.9	297
	Shaping the schedule based on weekly instructor guidance	17.9	61.1
	Adhering to the official calendar	39.3	9.3
Weekly timeline	Time allocated for analysis and synthesis studies	70	80
	Time allocated for jury assessments	70	70
	Time for 3D modeling and representation	56	40
	Time for system detail drawings	46	30
	Time for research activities	60	80
	Time for 2D expression techniques	64	48
Educator-learner role	Educator as a guide, student as a responsible learner	60.7	46.3
	An experienced and inexperienced pair jointly exploring knowledge	28.6	27.8
	Master-apprentice learning model	7.1	25.9
Knowledge and skills	"Integrating experiential knowledge with conceptual understanding instead of relying on absolute facts"	80	25
	"Encouraged to think relationally and generate new, open-ended ideas"	63	42.5
Integration of theoretical knowledge into design studio	Using knowledge and skills gained from theoretical courses in studio, students can partly integrate them	67.9	63
Course outcomes	Encouraging research through thematic topics	76	72
	Providing an environment open to critical thinking	76	70
	Integrating theoretical knowledge into projects	60	
	Preparing students for professional practice	54	52
	Engaging in theoretical discussions		60
Challenge in the process	Developing conceptual ideas	75	
	Critical thinking	64	46
	Synthesizing information from analyses	64	
	Sustaining model-making throughout the semester		62
	Completing drawings on time		60
Prerequisites for improving studio success	Conducting theoretical readings	•	
	Developing inquiry skills	•	
	Engaging in sketching and model-making activities	•	
Areas where instructors are perceived as insufficient	Mastery of digital technologies	39.3	57.4
	Communication with students	21.4	
	Fair and inclusive approach toward students		38.8
Evaluation criteria	"Analyses, research, and technical drawings should be graded separately, and their weight in the final grade should be shared with students."	53.5	64.8

Table 3. Comparison of instructors' and students' perspectives on IBL.

Elements of IBL	Topics and Indicators	Educator (%)	Learner (%)
Educator-learner relationship	Guidance from the studio instructor	60.7	37
	Conducted jointly with the studio instructor	21.4	55.6
	Conducted individually by the student	7.1	–
	Conducted collaboratively by student groups		1.9
Role of research in studio	"Research should be reviewed, discussed, and linked to experiences with the studio instructor."	78	88
	"Each stage of the project requires different research levels; the studio schedule should be revised accordingly."	76	84
	"Research should integrate with real-life experiences and enable learning from real contexts."	74	84
	"Research process should be organized as group work, discussed, and evaluated collectively."	60	52
Inquiry levels	"The research question, method, and solution should be predefined by the instructor." (confirmation inquiry)	3.6	3.7
	"The research question, method, and solution should be undefined and left to the student." (open inquiry)	25	27.8
	"The research question should be defined by the instructor, but methods selected by students and solution still open." (guided inquiry)	35.7	40.7
	"The research question and method defined by the instructor, but solution remains open." (structured inquiry)	53.6	42.6
Stimulus for inquiry	An open-ended research question	39.3	–
	A problem statement	25	–
Representation of research outputs	2D drawings	64.3	40.7
	Project animation	42.9	22.2
	Research reports	39.3	59.3
	Physical models showing system details	32.1	30
	Short film	32.1	16.7

and dissemination formats). Overall, the findings suggest that integrating inquiry depends less on adopting discrete "active learning methods" than on aligning tasks, guidance, and assessment cues in ways that are consistent and comprehensible to students (Tables 2 and 3).

Program planning reveals a mismatch in how "flexibility" is experienced. While many educators described adapting the schedule in response to student progress, learners more often experienced pacing as being shaped by weekly instructor directives. This distinction is important because what is intended as adaptive

pacing may be perceived as externally controlled timing, potentially weakening students' ownership of time management and making inquiry planning less predictable.

Both groups rated research and analysis-synthesis time relatively positively and largely agreed that research should be reviewed with the instructor and linked to studio experience. However, student comments suggest that research does not consistently translate into design changes. Therefore, the issue is not the quantity of research but the visibility of transfer, that is, whether interim tasks and feedback routines explicitly require students to convert findings into spatial and strategic decisions.

Time allocation patterns indicate a clear production bottleneck. Both groups identified system detailing and 3D modelling and production as time-constrained, and learners additionally reported greater pressure on 2D representation than educators. Compressed detailing and representation phases can reshape inquiry trajectories by forcing premature technical closure when production requirements accumulate later in the term. The discrepancy regarding the 2D representation also suggests differing assumptions about representational workload and the level of instructional support acquired to meet drawing standards.

Regarding instructor-student roles, both groups preferred a "guiding instructor-responsible learner" model over a master-apprentice relationship. However, a substantial minority of learners continued to endorse apprenticeship, indicating uneven expectations regarding authority and critique. In parallel, responses to inquiry design suggest stronger preferences for structured or guided formats than for fully open inquiry, implying that autonomy is most valued when supported by explicit scaffolding.

The learning outcomes demonstrate convergence on both the strengths and weaknesses of the studio. Thematic research and critical thinking were rated highly by both groups, whereas preparation for professional practice received more modest evaluations. Indicators related to partial integration: educators emphasized limited uptake in projects, while learners highlighted restricted opportunities for sustained theoretical discussion. This suggests that theory integration is not only a content issue, but also a studio discourse issue. Without structured moments that demand conceptual articulation, such as prompts, interim criteria, and critique formats requiring theoretical justification, theory tends to remain "partially used" rather than functioning as a decision-making tool.

Finally, both groups prioritized fairness and transparency, with learners expressing a stronger preference for the explicit weighting of assessment components. The sharpest divergence concerned the make-up examination policy: educators opposed it in the name of process continuity, whereas learners supported it due to workload peaks and unforeseen contingencies. This contrast reflects the competing logic of fairness and reinforces the view that assessment design is not merely an endpoint but a condition that shapes participation, pacing, and risk-taking throughout the semester. Overall, the findings highlight recurring conditions that mediate inquiry integration in the studio: the legibility of sequencing, calibration of guidance and agency, and alignment of assessment and dissemination with process-based learning. The framework model proposed in the next section is built directly on these conditions by translating them into coordinated tasks, guidance roles, and assessment and dissemination strategies.

5. Conclusion

This study demonstrates how an architectural design studio can operate as an IBL environment by repositioning research from a supportive activity to a generative driver of the design thinking. A comparative analysis of educator and learner perspectives indicated a shared view of inquiry as a catalyst for autonomy, critical reflection, and creativity. In addition, it reveals persistent constraints related to pacing, the translation of research into design, and the digital conditions of studio work.

Both groups agreed that the time allocated for the analysis and synthesis was generally sufficient. However, learners reported difficulties in carrying research outcomes forward into design development, with extended analytical phases sometimes weakening the design momentum. In parallel, fluctuations in weekly pacing and compressed production periods limit the time available for technical detailing and three-dimensional development. Despite these challenges, there was a strong consensus on the pedagogical value of the "instructor-as-guide, student-as-responsible-learner" model, underscoring the need for a calibrated balance between structure and autonomy in studio learning settings.

Building on these findings, this study proposes a three-part framework to strengthen IBL in architectural studio education:

(1) Definition of Learning Objectives: Clear articulation of learning outcomes at the outset helps align educator intentions with learner experiences. Framing research as a continuous driver of design, rather than as a preliminary, isolated phase, supports conceptual coherence and iterative development. The findings highlight the importance of objectives that explicitly connect research evidence to design stages, clarifying how inquiry informs the conceptualization, synthesis, and representation.

(2) Determination of Assessment Strategies: The results indicate learners' demand for fairness, transparency, and consistency in grading, alongside difficulties in managing shifting timelines. Predetermined criteria with explicit weighting across research, analysis, representation, and technical detailing can support accountability and achieve more realistic pacing. Embedding formative checkpoints (e.g., interim reviews and brief reflective self-assessments) can further sustain motivation and render feedback cycles more equitable and process-sensitive.

(3) Development of an Adaptive Learning Framework: The proposed framework embeds inquiry-based tasks across a semester cycle, balancing structured and guided inquiries. Each two-week phase of the model (Table 4) corresponds to distinct inquiry stages, orientation, exploration, conceptualization, preliminary design, development, detailing, and dissemination, aligning specific tasks, spaces and technologies, tutoring and peer interaction, and assessment and dissemination practices. The evaluation further suggests that both educators and learners prefer guided and structured inquiries in complex studio contexts, underscoring the pedagogical function of scaffolding. In terms of inquiry modes, pursuing and authoring received the strongest endorsement, reflecting preference of autonomy and responsibility within legible structures. As a practical contribution, the framework can function as a planning tool to coordinate pacing across studio sections, standardize minimum levels of assessment transparency, and stabilize research-to-design transfers through interim outputs and feedback routines.

Across these phases, the studio unfolds as an interconnected cycle of inquiry and design. Orientation and framing support the formulation of research questions and the establishment of learning expectations; exploration consolidates fieldwork and evidence; conceptualization translates analytical findings into scenarios and design logics; preliminary design and development convert these insights into two- and three-dimensional proposals; detailing integrates technical and environmental considerations; and evaluation and dissemination culminate in juries and public-facing representations that foreground synthesis and reflection.

By mapping studio activities onto the framework's five dimensions, the model operationalizes inquiry-based pedagogy in a structured and adaptable manner. It supports progression from tutor-supported inquiry toward more autonomous authorship, positioning students as active co-creators of knowledge while strengthening transferable capacities in research, collaboration, critical reflection and representation. Although this study is grounded in a single studio within one institutional context, the framework is offered as a transferable scaffold rather than a fixed

Table 4. Two-week phased inquiry-based studio model.

	Elements of IBL				
Weeks	Tasks	Information	Spaces & Technologies	Tutoring & Peer-to-Peer	Assessment & Dissemination
1–2 Orientation & Framing	Defining research questions, framing problem areas	Readings, reference projects, site preparation	Shared studio, online idea boards	Instructor-led orientation, small group exchanges	Clarification of goals & expectations
3–4 Exploration	Fieldwork, ecological/urban data collection	Databases, maps, surveys, literature	Site visits, GIS/AR visualization	Joint review of findings with peers & tutors	Submission of "Data & Findings Report"
5–6 Conceptualization	Scenario-building, refining research questions	Concept diagrams, case comparisons	Workshop, digital storyboard tools	Peer critique cycles, instructor questioning	First interim review (conceptual approach)
7–8 Preliminary Design	Linking site data with program & functions	Program diagrams, typologies	Studio, digital modeling (Rhino/Revit)	Tutorials + peer assessment	Interim jury (program & concept clarity)
9–10 Development	Advancing spatial organization, 2D/3D representation	Plans, sections, models	Model-making workshops, rendering tools	Peer feedback + weekly tutorials	Second interim jury (design integration)
11–12 Detailing & Integration	Systems, material selection, environmental integration	Technical drawings, simulations, catalogues	Simulation labs, CAD/BIM studios	Iterative tutor feedback + peer input	Submission of detailed design package
13–14 Evaluation & Dissemination	Finalizing project outputs, reflection	Final report, animations, panels	Exhibition venues, online platforms	Rehearsal critiques, peer review	Final jury + exhibition + digital dissemination

prescription. Its phases and dimensions can be recalibrated across studio cultures by adjusting the deliverable density, feedback checkpoints, and the balance between guidance and agency in line with local resources, critique traditions, and curricular priorities.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This study was supported by Yildiz Technical University, Scientific Research Projects Coordination Unit (Project No: 5114).

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Data availability statement

Data are available on request due to privacy and ethical restrictions. The data that support the findings of this study are available on request from the corresponding author, N.H.E. The data are not publicly available because they contain information that could compromise the privacy of research participants.

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