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Extraction Process of Precedent Study in the Student Studio Scheme (Study Case: Third Semester Architecture Student at ITS)

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Abstract. A precedent is a piece of design knowledge that acts as an input to the design process. On the other hand, the originality of architectural design is built from many interpretations that occur within the designers, including the performance in the precedent study. However, more information still needs to be provided about how students seek, read, and apply precedents during the naturally occurring design process. Architecture students have limitations in developing a design, considering they need more experience and knowledge than practitioners. This research is conducted in qualitative which is based on the learning-by-doing experience of architecture students when designing a housing project. The research involves the participants of third-semester architecture students, which includes observation during the studio class and interviews. The portfolio documents are also used to support the data itself. The result shows that architectural precedents are sought at every phase of the design process. The precedent that has already been seen or even analyzed becomes part of the designer's tacit knowledge. The study contributes to the architecture theory, especially for architecture education.

Keywords: precedent, architecture theory, design process

1. Introduction

Architecture significantly shapes originality not through novel discoveries, but rather by interpreting and diversifying existing elements (Simitch & Warke, 2014). Architectural complexity arises from the intersection of diverse thematic patterns, yielding multiple interpretations and layers (Clark & Pause, 2012). Design, intrinsic to architectural education, serves as a problem-solving mechanism and a mode of inquiry, integrating knowledge from various sources into a cohesive understanding (Taneri & Dogan, 2021). However, the challenge persists in coordinating these knowledge sources into a more cohesive cognitive design motion (Downton, 2013; Fulgencio & Asino, 2021; Plowright, 2014).

The intuitive process in design, emphasizing individual cognitive experiences (Lang, 1987), influences each student's design process. Architectural studios, central to education, function as ecosystems fostering experiential learning (Doheim & Yusof, 2020; Mutaqi, 2018; Schön, 1988). Creativity, vital in idea development, is significantly impacted by instructor involvement (Baghaei Daemei & Safari, 2018; Soliman, 2017; Taneri & Dogan, 2021; Tzonis, 2014). (Zarzar, 2003) underscores that examining precedents introduces intricacies into the design process. The utilization of precedents is not merely derivative; it constitutes a creative process contributing to innovative designs. Research on architectural design studios and the role of precedents shows impacts on knowledge acquisition and proficiency levels (Cürgen & Gürpinar, 2016; Eldardiry & Elghonaimy, 2017; Türkkan, 2016).

Scholars have proposed design methodologies with precedents as central sources, including typological frameworks (Grover et al., 2018), pattern-based frameworks (Plowright, 2014), and precedent-based design (Eilouti, 2009). Notably, these studies focus on contextualized

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conditions. Zarzar (2003) highlights that precedents are adapted and recombined based on designers' contextual needs. Djari's (2019) research on visualization's impact on experienced architects reveals heightened productivity, process efficiency, and effectiveness in minimizing repetitive cognitive actions. Therefore, this study aims to discover how the students, as a beginner designer, use and extract the precedents for their design project.

2. Methods

Downton (2013) mentioned three types of relationships between research and design in design research, and this research is the research through design type. Designing utilizes knowledge inferred from sources outside of design and sources inside the designer's discipline. It produces new knowledge for the designer, whether it is a new understanding, insights into how to get a wanted conclusion, or a fulfilling course of action of components. Therefore, this type of research seeks into the design process to obtain knowledge from it.

The worldview of the research is critical theory since it discovers the precedent consistency in the design process of architecture students. Critical theory receives a subjectivist epistemology whereby information rises as the researcher and respondents co-create an understanding of the circumstance or setting being examined (Spence, 2017). This research's critical theory worldview (Spence, 2017) or intersubjective paradigm (Groat & Wang, 2013) is conducted in qualitative research where the research points out the natural settings of the subjects. The study is conducted with a single case study, which takes place in one of the architecture student studios in ITS, Surabaya. Participants are early second-year or third-semester architecture students. This selection was because, that semester, their architectural design studio emphasized using precedents as a critical element in design.

1) Participants. The study focuses on a third-semester studio within ITS, International Undergraduate Program (IUP), consisting of 21 students divided into two supervisor groups. The first group comprises eleven active participants, whom the researcher actively engages with, observes in every studio meeting, and interviews during discussions. The second group, consisting of ten passive participants, serves as enrichment data, with observations limited to studio presentations and brief interactions. The division is based on two lecturers leading the class with their respective groups. This differentiation in participant treatment aims to underscore aspects of researcher accessibility and acceptability, facilitating deeper and richer data collection as relationships with participants deepen. The treatment for all 21 students involves observable and known observation during discussions and presentations, maintaining a researcher's distance from participants (referred to as observer as a participant).
2) Data collection. The data was obtained by observing, interviewing, and collecting participant documents (design portfolio). This research was divided into two periods; during the first period, when the studio was in progress, the researchers conducted observations and brief interviews. The researcher's position is an observer as a participant, where the researcher's observer activities are known and may have access to the participants without participating in the participants' activity (Merriam & Tisdell, 2015). A semi-structured interview was conducted three months later to obtain more accurate results as a form of triangulation. The guide is not intended to be read verbatim in the same order in every interview but rather to provide structure and focus to each unique interview's natural flow of conversation. A semi-structured interview guide often includes main open-ended questions with follow-up probe questions for the interviewer to refer to throughout the interview (Adeoye-Olatunde & Olenik, 2021; McIntosh & Morse, 2015). In addition, the participants are also asked to share what precedents are used in every stage of the design process. The documentation in research through design is important to see the design process of the designer (Sadokierski, 2020).
3) Data Analyses. Adapted from one of the qualitative research approaches, which is grounded theory by Charmaz (2006), coding, making memos, and theoretical sampling are

done to discover the new "theory" about the precedent study. Coding means simultaneously categorizing, summarizing, and accounting for each piece of data. Memo-writing is taken during the research process to keep track of the researcher's thoughts and ideas.

4) Finally, is the conclusion. All the code and memos are arranged to be categorized and crosschecked with the theoretical sampling. Later it will emerge a new idea or conclusion despite the existing theory.

Table 3.1 Participants Project (Author, 2023)

No.	Participant	Gender	Design object (House +)
1	Itha	F	Culinary pick-up store + Office
2	Ifa	F	Boutique + Office
3	Ade	M	Boutique
4	Bila	F	Office
5	Inu	M	Photography studio
6	Kai	M	Mini market
7	Uki	M	Clinic
8	Thani	F	Herbal store
9	Dimi	F	Culinary pick-up store + Office
10	Yara	M	Boutique
11	Drew	M	Workshop studio
12	Kay	F	Home Business
13	Dave	M	Boutique
14	Neli	F	Café
15	Alya	F	Culinary
16	Billy	M	Office
17	Nana	F	Office
18	Bram	M	Home Business
19	Nick	M	Boarding house
20	Ira	F	Herbal store
21	Apin	M	Store

3. Discussion

It is crucial to shed light on how students incorporate precedent studies in real-world scenarios, specifically within the context of architecture student studios. This chapter thoroughly explores the findings of a qualitative study, drawing from a variety of data sources including observations, interviews, and the examination of participants' documents (portfolios). The integration of diverse data modalities provides a comprehensive understanding of the multifaceted ways in which students engage with precedent studies throughout an entire academic semester. Serving as a preliminary introduction, this research case study delineates the studio setting, elucidating its thematic focus, duration, and educational environment. Subsequently, the ensuing discussion delves into emerging aspects not exhaustively covered in existing theoretical frameworks.

3.1. The Studio Settings

The Architectural Design Studio I course, held at ITS, is intended for third-semester students. The theme of the architectural design studio is to design a dwelling that not only functions as a place to live but can also be used as a place to work or do business. The studio uses Plowright's (2014) theoretical pattern-based framework to help map out the design process. For this reason, students are required to find clients who act as future users in their designs. The client tells all their needs, wants, and preferences regarding the income generated. The project of the students can be seen in Table 3.1.

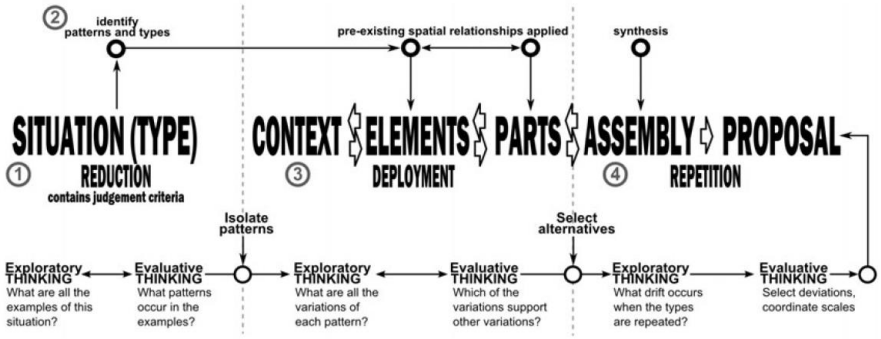

Figure 3.1 Pattern-based Framework (Plowright, 2014)

The pattern-based framework initially originated from the contributions of Durrand and subsequently underwent further development by Plowright (2014), as delineated in Figure 3.1. According to Plowright, the tool employed for pattern development in the design context is derived from precedents, whether presented in an individual or comparative form. In adherence to the assignment brief, students are mandated to identify and analyze a minimum of five precedents, with the option to extend their inquiry. A pivotal aspect within this framework is the imperative for students to discern primary social information guiding the identification of isolated patterns resulting from the precedent analysis.

Throughout this process, students endeavor to derive these isolated patterns through comparative analyses of precedents. The outcomes of these isolated patterns subsequently serve as guiding principles for students' design endeavors, allowing for adaptability to the specific design context. Given the studio's directive for students to design residences with income-generating functionalities, students further seek precedents that align, at minimum, with the type or function stipulated in the design brief.

Table 3.2 Coding (Author, 2023)

Before Eval. I	Eval. I – Eval. II	Eval. II – Eval. III	Eval. III – Final
Week 1-5	**Week 6-10**	**Week 11-14**	**Week 15-16**
- Finding the precedents based on typology - Highlighting the aspect that wants to be solved - Establishing the specific desire of the client - Defining the style: spatial quality, material, elements, and feature - Looking for how to separate the public and private space - Reading the precedents' description - Choosing the precedent that gives ~~a~~ visual pleasure - Having difficulty finding the exact precedents with the same typology	- Overwhelmed information - Having the "initial room" - Communication for delivering the design exploration - Expanding the room organization - Concerning the site analysis - Main element - Keyword limitation - Customizing the design typology - Doubt themself to start with something different. - Style - Analyzing the room programming - Determining the private and public space - Exploring the mass and program	- Doing the design iteratively - Having one pivotal aspect/thing/element - Developing the iteration - Combining the iteration - Choosing what works best for the designer - Trying to accommodate all the client's wants and needs - Distinguishing the façade - (Some students) Only looking at the big picture of the zoning (precedents), not the relation among rooms - Feeling satisfied with the result of the design	- Instant or personal idea - Detailing the drawings - Making mood boards for the interior - Checking with the design criteria - Insisting on the personal idea (did not want to revise) - Fixing the accessibility - Making the visual communication clearly - Changing the design priority - Paying little attention to utility consequences - Personal ideas over the precedents

The students have 16 weeks to complete this project, divided into several design phases. In each phase, students must achieve several objectives that will be evaluated by the lecturer. There are four evaluations in total, and the fourth is a cross-evaluation. For the initial task, students must find the definitions of home and domestic activities related to income-generating activity. In the first phase, students were asked to find a client and detail the client's needs and wants. From the results, students must also formulate design criteria and look for precedents matching their design needs. In the second phase, students enter the basic design, starting by analyzing the precedents they have determined. In the third phase, the design drawings enter the details, including the facade and structure. The days before the evaluation are used to assist their respective lecturers, where students can discuss the design together. The researcher engaged in observational analysis and conducted rudimentary interviews with a cohort of students to ascertain the prevailing conditions within the design studio during that semester. Subsequently, the prospect of interviewing diverse students in the subsequent phase holds the potential to yield varied and complementary information. The coding system employed for each distinct phase is documented in Table 3.2.

3.2. Precedent Implementation Throughout the Design Process

Eilouti (2009) introduced a design model termed precedent-based design (PBD), emphasizing the utilization of precedents. As illustrated in Figure 3.2, the model explicates the facets encompassed within the precedent implementation. Commencing from the leftmost column, denoting straightforward precedent implementations, the progression extends towards the right, elucidating intricate actions and categorizations inherent in the precedent implementation. The overarching framework comprises three phases, pre-design, design, and post-design phase.

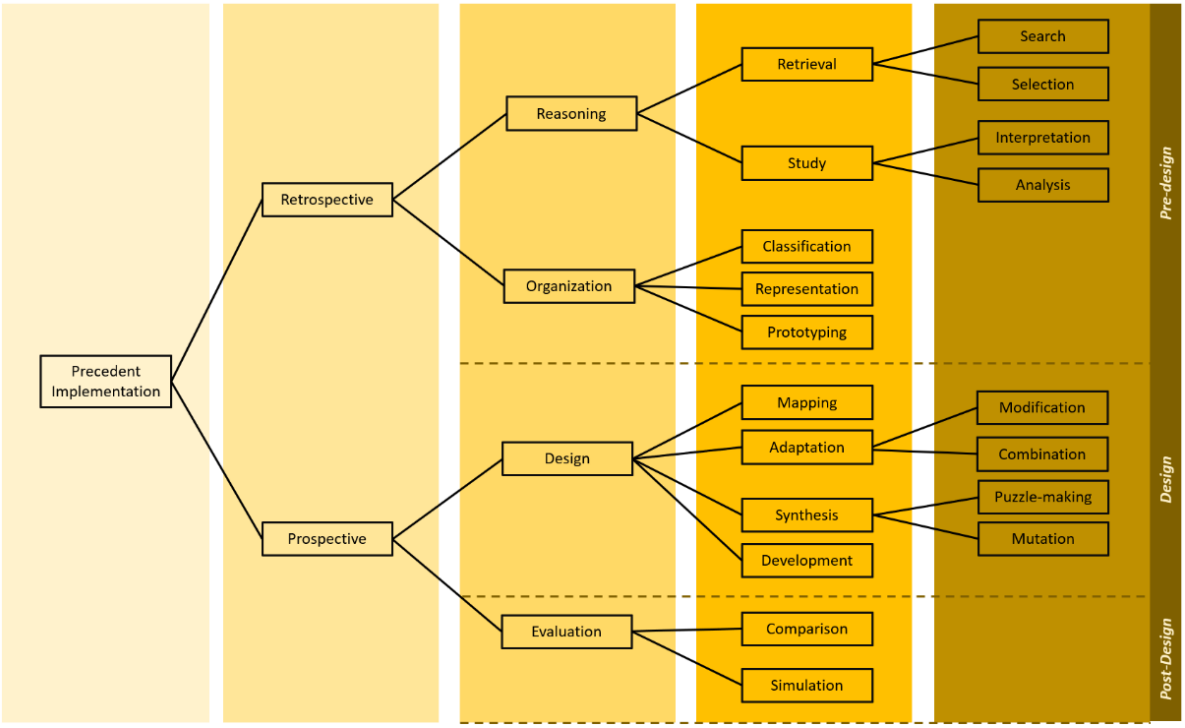

Figure 3. 2 Precedent Implementation (Eilouti, 2009)

During the pre-design phase, a systematic search is conducted for precedents relevant to identified needs. Subsequently, these precedents are carefully selected, interpreted, and analyzed in alignment with predefined design criteria and objectives. The information gleaned

from the precedents is systematically organized and presented in a simplified format, enhancing accessibility for subsequent reuse.

Moving into the design stage, prior results are initially mapped to assess the feasibility of employing certain approaches or methods in the current design context. Adaptations, modifications, and combinations of the mapped outcomes are then executed, integrating them with the design problem to generate a comprehensive design solution. The final step entails an evaluative process, wherein the generated design solutions are scrutinized in comparison with existing precedents. Furthermore, this evaluation is cross-verified against the initially established design criteria to ensure alignment and adherence to the predefined objectives.

1) Pre-design

As shown in Figure 3.2, Eilouti (2009) mentions several detailed actions that occur in the pre-design stage. Looking at the diagram, each action seems separate and more hierarchical, but keywords have been detailed. For example, there is the activity of retrieval and study when it comes to reasoning. Then, search and selection are the actions that occur in retrieval and reasoning. They work the same way as the other terms or acts. Architecture students do not linearly perform these actions but in a looping or repetitive way.

Based on the explanation of the clients (Figure 3.3), the students list the client's wants and needs based on some points: spatial requirements, site preferences, design preferences, and business choices. Some also detail the characteristics of each user, like what Itha and Bila do. The students can infer their design project's design criteria or response by listing their wants and needs. From this point, it helps the students to determine the keywords for their precedents search.

Students generally look for precedents starting with the type of building typology to be designed, namely around housing and the business itself. Not only typology things like style are also their consideration in finding the required precedent. Laseau (2000) mentioned the client's wants and needs from the design program. However, some students need help determining keywords for their precedent search. The keywords used cannot be fixed to the initial keywords. The students' idealism to get a precedent that directly matches their future design was impossible to fulfill by the facts of reality.

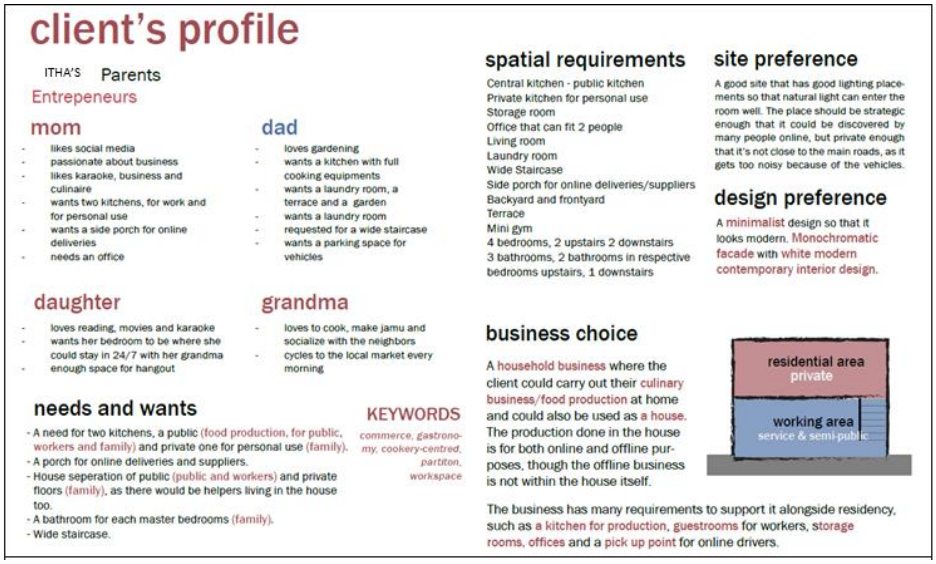

Figure 3.3 Client's Profile (Participant: Itha, 2022)

After finding the appropriate precedents, students begin to study the precedents. Students analyze certain aspects using appropriate design tools (plan, section, elevation). After understanding the architectural aspects of each precedent, students collect the architectural objects with common relationships to extract the common root of information to get the type of that precedent. This is because, as a pattern-based framework, type is created by a "process of reducing a complex of formal variants to a common root form." A large collection of architectural objects with common relationships can be understood by their common characteristics, regardless of individual differences (Plowright, 2014).

As shown in Figure 3.4, the precedent study conducted by Inu uses various design tools that have been provided, from elevation or perspective view, plan, section, and 3D section. The sections that are shown aim to inform the circulation of air. The floor plan can inform Inu to understand the room programming and movement circulation. Meanwhile, the elevation and perspective images show ~~how~~ the visual expression of the house. Inu also provided colorful lines to show what architectural aspects he learned from the precedent.

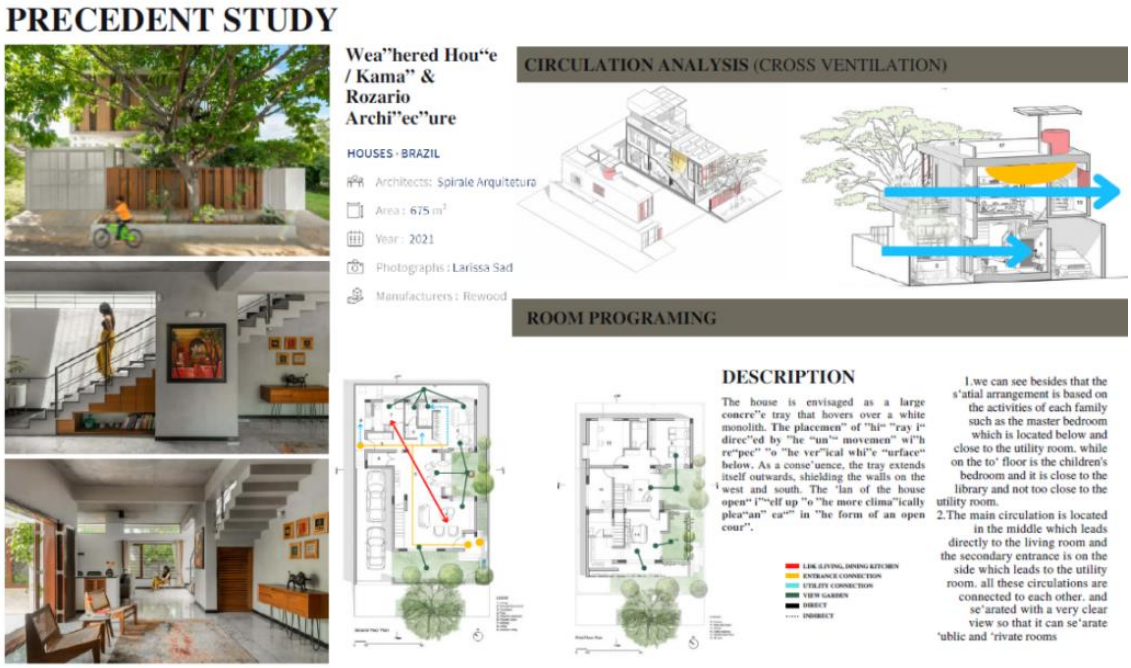

Figure 3.4 Precedent Study (Participant: Inu, 2022)

The organizing activity diverges into classifying its analyzed layers, representing the extracted information in more accessible forms, and prototyping its representations to serve as templates for future design solutions. As shown in Figure 3.5, what the students have already done shows that they have indirectly categorized the precedents based on their needs. The way they do this is also a way to extract the common root explained above. Dimi tries to understand the façade composition and proportion. In this action, the designer can create a representation that is easy to learn and then create a prototype that will later be used for the designer's design.

Figure 3.5 Prototype of Precedent (Participant: Dimi, 2022)

2) Design

Based on the observation, as students enter the second evaluation, they begin to make some preliminary designs. These preliminary designs are rough sketches of space programming, massing, or façade plans. What the students learned in the precedent study to make comparisons is ultimately used in the design and adapted to the context of their site. They focus on one of these aspects and create several designs, which can also be referred to as design iterations. The iterations can lead to an evolution of the design.

The process that students experience varies from one another. What is certain is that students have at least pivotal things or aspects that they want to develop more. An example is what Inu does, where he starts his design with massing adjusted to the site conditions. Inu did the iteration of voids several times, and in the end, he combined the three iterations, as seen in Figure 3.9. After getting the result of the last iteration, the room programming goes into the massing. Inu does a process that is quite organized or has its sequence. Some other students do much exploration so that each alternative produced has no continuity with the other. It has a different character.

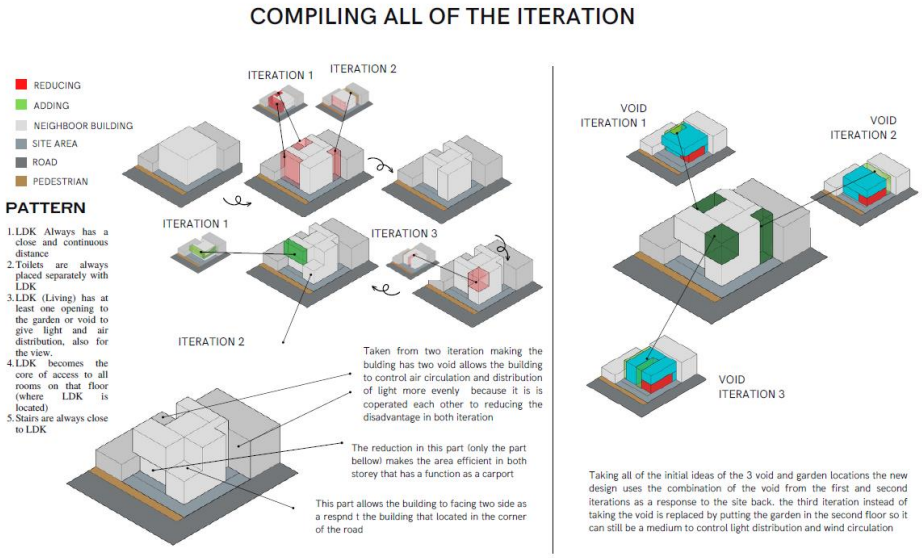

Figure 3.6 Massing Iteration (Participant: Inu, 2022)

The decision of which alternative or iteration to use next is entirely the choice and judgment of the students themselves. Factors influencing this judgment may come from the initial brief, such as the limit on the floor area or the number of stories. At this stage, students do much exploration to propose design alternatives. Then, they must choose (evaluative) the best solution to their design problem.

3) Post-design
Eilouti (2009) mentioned that several things are done in the post-design phase, including comparing a generated solution with other precedents that can be considered successful solutions and simulating the performance of some proposed scenarios of the generated design. After selecting the appropriate iteration, students develop their choices into design details. Students also search again for precedents needed to complete their details at this stage. The precedent sought at this stage is more to show a visually appealing image.

The concept of knowledge recycling, as emphasized by Eilouti (2009), is crucial for comprehending the utilization of precedents in design. To transform raw information from precedents into a meaningful knowledge base, it is essential to interpret and process the data extracted. This interpretation and processing serve as prerequisites for establishing a meaningful information foundation. Consequently, the extracted data undergoes interpretation and transformation, resulting in structured and organized abstract knowledge models. Information related to formal building aspects is denoted as *normative fit*, while information obtained from clients is termed *requirement fit*. Given the interplay of these influences, it can be asserted that a form of negotiation takes place during the pre-design or retrospective stage.

3.3. Precedent Build the Tacit Knowledge

The use of organized precedents, as in this case study, helps students to be able to analyze well. It looks very organized from the description of the design problem, precedent search, analysis, design, and development proposal. Not only studying precedents, but students must also readjust to the context of their respective sites. Apart from the coherent process, students as designers also experience automation in design due to the accumulated design knowledge. Precedent, as design knowledge, sometimes has an effect that the designer does not realize.

Downton (2013) mentioned that the existing knowledge of the designer is automatically brought to the process of designing. The knowledge is also gained from the learning environments and builds up the designer's intuition (Plowright, 2014)—for example, some students in the case study. Ifa iterated several times but ended up with the design seen in Figure 3.7. Only during the interview did I realize that I was influenced by one of her precedents, which gave a visualization of a staircase. Whereas in her portfolio, the participant only compares the space circulation. It shows that what has been seen or learned will indirectly be stored in the mind, become a piece of knowledge, and influence the design. What Ifa has experienced is included in tacit knowledge, which is the knowledge that is difficult to document and transfer a conception of knowledge in a way of doing. It isn't easy because what the designer experiences happens automatically or unconsciously.

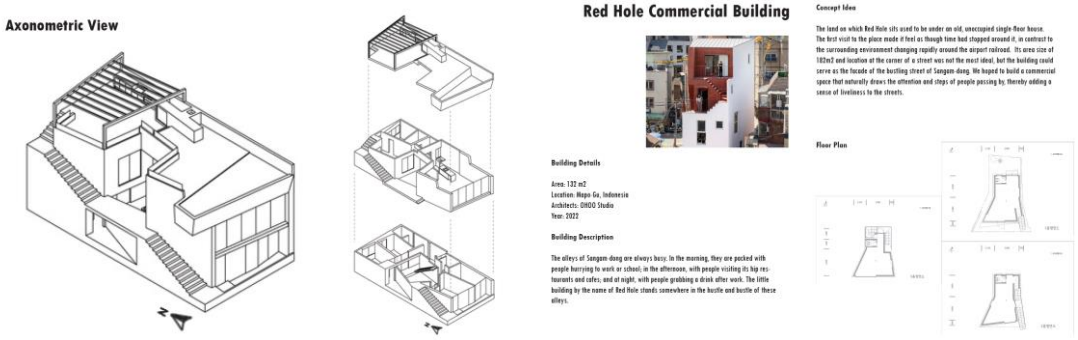

Figure 3.7 Design and the Precedent Source of Idea (Participant: Ifa, 2022)

4. Conclusion

This research explored new issues relating to architectural theory about the design process. There have been some theories and research discussing precedent studies in architecture, such as Eilouti (2009), Zarzar (2003), and Clark & Pause (2013). Throughout the phases of pre-design, design, and post-design, students engage in self-directed adjustments. The compatibility with norms and requisites concurrently shapes precedents and dictates the analytical approach applied. The progression involves a nuanced negotiation process aimed at obtaining pertinent precedent studies beneficial to students. This, in turn, facilitates the accumulation of latent ideas within students' cognitive reserves, augmenting their tacit knowledge.

The anticipated outcome of this study is deemed valuable for architectural education. The selected educational context in this research endeavors to observe and assess the effectiveness of precedent studies in student design. Instructors can enhance their teaching methodologies by conducting comprehensive analyses of diverse design tools available from various precedent sources. Consequently, students can develop a heightened sensitivity to information derived from precedents and can adeptly tailor their utilization according to their specific requirements, avoiding overwhelm. In the bigger picture, this study wants to develop the scope of architecture in architecture procedural theory (Lang, 1987) the theory of how to design (Attoe, 1979), and the theory of design knowledge (Downton, 2013).

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