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# INVESTIGATING 'COLLAGE' AS A TOOL FOR CRITICAL THINKING IN THE CONCEPT DEVELOPMENT PROCESS OF INTERIOR ARCHITECTURE

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**Abstract.** In the Interior Architecture Design Studio, students often struggle with thinking and decision-making affecting the quality of their design outcomes. This compels the quest of understanding 'collage' as a tool for critical thinking, during conceptualising in the design process. There is limited literature related to this connection and a gap is felt in comparing the 'collaging' with the 'critical thinking skills'. This research investigates 'collage' by reviewing the literature to understand its connection with architecture. Architect Tatiana Bilbao's case studies, who uses collages over renderings provide a new perspective towards collaging. A study conducted at the 3rd year Interior Architecture Design Studio at a University in Ahmedabad, India, investigates collage's effectiveness in decision-making when students use collage. The study is limited to collaging and model-making and does not explore other tools. It establishes collage's effectiveness by contributing an approach that focuses on critical thinking for decision-making to achieve better quality designs in architecture and interior academia and practice.

## 1.    Introduction

Architectural and interior space design education constantly needs innovative pedagogies to make students better critical thinkers and problem solvers. Brookfield (2011) mentions that several students' low attention span in the digital era and lack of cognitive stamina is a worldwide phenomenon and needs immediate attention. Students complain of being over-burdened by various subjects in the curricula, often show dependence on faculty and struggle in decision-making on several parameters in the creative design process (Kyndt *et al*., 2013; Roorda *et al*., 2020; Acar *et al*., 2009). Their design outcomes often reflect a lack of critical thinking. Alexander (1982) argued that in the creative process, attention to 'design as a stage in decision-making' is crucial as it leads to significant improvements in the quality of outcomes. There is a constant need to consciously select appropriate design tools that help in decision-making while focusing on critical thinking; in this quest, collage as a tool demands multifaceted explorations. Simmons and Daley (2013) used collage to stimulate scholarly work instead of writing while developing research questions. There is limited literature that connects collaging to critical thinking through various mixed methods in the field of interior architecture.

Therefore, this research investigates the role of 'collage' and 'collaging' in the concept development process focusing on critical thinking in Interior Architecture Design Studio.

Fundamentally, collage as an artistic expression leads the receivers to new visions and knowledge through confrontation, critical self-reflection and personal experiences. Many architects have demonstrated the potential of collage through, theory or the physical manifestations of built-forms. Specifically, the Mexican architect Tatiana Bilbao showcases the importance of collage in her design process, how its open-ended qualities lead to further design explorations and therefore her philosophies need explorations in the academic design studio. Kelly (1955) pointed out, that we continue to develop our thinking skills and negotiate our environs throughout our lifetime. As the cognitive processes of critical thinking are inherent in collaging, deciphering its connections with critical thinking to guide students in conscious decision-making in design education would lead to newer insights.

The 3rd year design studio having 30 students in a section of the undergraduate Interior Architecture (Space Design) program of a University in Ahmedabad, India used collage while exploring it as an interface between reality and vision. The hypothesis for this exercise was that the students learn more effectively and think critically during the concept development stage when digital collaging and physical model-making are combined. The research question was how the collaging process helped students in critical thinking and decision-making. Designing with collaging in the studio has provided the opportunity to validate its theory. Through surveys and interviews, the research shows how students think critically while attempting to express their vision for their design and how collages help in reflecting upon several design parameters related to interior architecture and provide further design directions. The research contributes an approach that involves metacognitive thinking while collaging, to help students in decision-making, leading to the enhancement of architecture and interior design practice.

### 1.1. Methodology

The research consists of four parts and is based on a mixed methodological approach that studies theory and cases and then implements it into teaching practice through a pedagogical experiment. Firstly, the literature review throws light on understanding collage and collaging and its connection with architecture. It further highlights various perspectives and possibilities related to collaging that establish the strength of collage as a design tool. Secondly, two cases of Tatiana Bilbao's works that show innovative explorations of collaging in professional practice are selected and analysed to understand her philosophy and methods of collaging and explore how they can be used in academia. Thirdly, the Critical Thinking process is studied starting with APA's Expert Consensus Delphi Report of 1992 and its further evolution by Facione (1990; 2011; 2015). These skills are then compared with collaging to establish similarities and explore the possibility of pushing the boundaries of critical thinking in design development. Fourthly, an experiment was conducted in the Interior Architecture Design studio that helped in testing and validating the theories of collage. Finally, the discussion and results lead to inferences highlighting the importance and methodology of using collage in Design Studios.
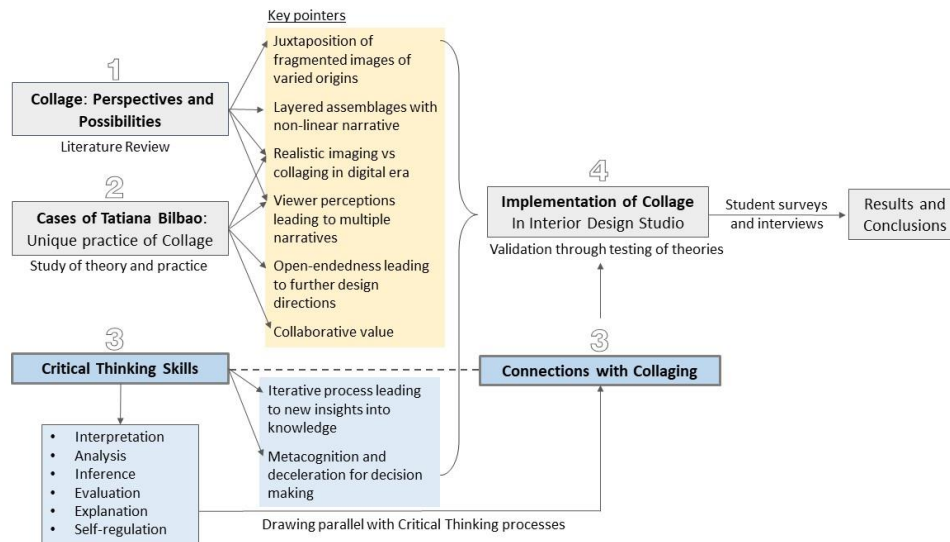
**Figure 1.** Methodological Process (Author)

## 1.2. Collage and Collaging

A collage begins on a two-dimensional surface and during 3D space visualisation, the maker's imagination, perception of spaces and how various decisions are made create an interesting scenario for investigation of the collaging method. In this process of collaging, various steps of selecting images or prints, cutting them out and layering to make a composition can be seen as generative phenomena. This imaginative process involves identifying associations, deliberating on interrelationships and creating new ideas (Simmons & Daley, 2013). The abstraction of complex contents results in remarkable and mind-opening visual statements. The poet Guillaume Apollinaire used the name 'collage' which originates from the French word 'coller', meaning 'to paste on a surface' (Cran, 2016). Various online dictionaries call it an artwork made by sticking various materials like photos, and papers on a backing. For Perloff (2002), this pasting process is just the beginning of a collage. Here, with the addition of each fragment, the maker begins thinking and transferring meanings into a composition. Cran (2016) sees collages as encounters that bring ideas into conversation with one another. According to Buchert (2014), collage calls for thinking beyond written and visual expressions. It involves, taking a position and action to the users and their environment based on temporal aspects. With this approach, the collage and architecture mediate between the world and humans, highlighting various facets that cannot be described conceptually or methodologically. Collage embodies the floating state between abstraction and realism originating a new, more embellished theatrical perspective.

## 1.3. Collage and Architecture

Pablo Picasso, Georges Braque and Juan Gris, the founders of cubism imagined collage as a 'hybridisation of painting and sculpture existing at the threshold of two and three dimensions'. Collage enables a new conception of space while inquiring into the possibilities of three-dimensional space in a two-dimensional medium (Shields, 2014). In architecture, collage is seen as an assemblage and the modernist architects Le Corbusier and Alvar Aalto have used the fusions of modern and vernacular images in their buildings.

Corbusier was greatly influenced by the Cubists' reconstruction of space and form through simultaneous perspectives (Shields, 2014). Frank Gehry deliberately designs buildings with inherent complexity, but they can still be seen as assemblages with different origins.

Pallaasma (2000) in her essay, 'Hapticity and Time' says that in today's era, collage and assemblage are the preferred techniques that facilitate 'archaeological density' and a 'non-linear narrative' through placing fragmented images from diverse origins that lead to the creation of an experience of tactility and temporality. Wehmeyer (2021) in her doctoral thesis interprets collage as not just a tool for representation of the present world or imagination of the future world, but the realm that creates its own reality through layering of different meanings and rationalities.

This is generated through the layered coexistence of fragmented images from varied backgrounds with no relationship with each other. Picasso and Braque worked in the analogue era, physically crafting their pictorial reality of amalgamation of the paintings and sculptures. This process has continued influencing architects and designers in their collaging even in today's digital era.

## 1.4. Realistic Imaging vs Collaging and Digital vs Analogue

In today's world, photorealistic renderings are widely used showcasing the visualisation of the outcome or the final reality of the designed spaces (Bern, 2023). Multiple softwares are widely available to create these realistic renderings that help to reach out to the masses to make them understand spaces proposed by designers. However, these renderings often lack many parameters that designers like to express and appear restrictive as they portray only one final meaning. Most commonly, the renderings are used as propaganda to promote projects and increase their saleability (González-Jiménez & Enia, 2023). The final renderings often do not explain how users or communities interact or the incrementality of spaces and do not possess the power of continuous development or further progression of the designs. Therefore, many leading architectural firms have shifted to using unrealistic, abstract visualisations or collages for their inherent qualities of being open to viewer interpretations. These are created using digital media, through several commonly used editing software.

Cascone (2017) coined the term 'post-digital' regarding music showing how digitisation led musicians to rediscover the analogue medium or sometimes create a mixed reality or hybridisation. This aimed to create a new reality using the best of both media. Similarly, digital collages create hybrid spaces at the threshold of reality and imagination. The collages are used intentionally for their quality of being non-realistic representations resulting in a mysterious feeling and an openness of interpretation. González-Jiménez and Enia (2023) call this 'photo(Un)Realism', projecting the hybridisation of analogue and digital methods of collaging. The collaging shows similarities with the parametric modelling of Gaha (2023), as both are iterative processes where designers select, operate and evaluate to create visuals connecting users to their possible future environments. The digital collaging resembles analogue artworks in terms of their compositions and colour patterns, evolving into a space with a sense of narrative potential. Today, AI is abundantly used as a generative processing tool and the resultant images can also be seen as collages.

### 1.5. *Narrative possibilities with perceptions of viewers*

Each image used in collaging brings its intrinsic ability to suggest possibilities. Collectively the composition created stands for different narratives for a specific atmosphere. The unfinished and unrealistic nature of the collage composition intentionally invites the viewers to have a dialogue where the viewers can create their own narratives based on their own past experiences and backgrounds. González-Jiménez and Enia (2023) point out that the viewers need to engage with the gaps consciously created by open-ended representation, thinking about the possible messages and ideas. The different environments generated by the collages are often tough to express in words but are clear in visuals, adding new meanings based on the viewers' perceptions. Therefore, Bilbao and several other practices use collages early in the design stages to explore the possibilities of endless narratives.

## 2.  Deciphering Tatiana Bilbao's process of collaging: Case studies

Recently, certain progressive thinking practices have begun to use collages, out of which Mexican architect Tatiana Bilbao stands out, as she is known for using collages extensively in her representations. She values the strengths of collaging and her philosophy about collaging and the innovative approaches are reflected in many of her works. Therefore, there is a need to study her work to understand how the learnings can uplift the design process in academia and practice. This article focuses on two of her projects that best exhibit her unique ways of collaging and studies the different steps involved in the collaging and decision-making that lead to unexpected, creative and empathetic design outcomes. The article studies the implementation of collages in professional practice generating new design approaches, perspectives and knowledge that can substantially help in future of architecture and interior designing.

Bilbao aims to integrate communal values, collaboration and sensitive design approaches into her work. In her interview with Dezeen (Frearson, 2019), Bilbao mentions that her architecture should create possibilities for people to develop their way of living; a collage exhibits those characteristics accepting multiplicities and complexities that go beyond her ideas. To her, realistic renderings are "dangerous and damaging". She announced that she banned realistic renderings from her studio's design process and continues to use collages for their 'collaborative' and 'open-ended' nature (Harriss *et al.*, 2023). In her interaction with collage Bilbao demonstrates a deepened creative and research-orientated approach to the process of design (Wehmeyer, 2021).

Bilbao describes her process of collaging in her project "Ways of Life".  She told the story of one of her collages from 2017 to Dezeen (Frearson, 2019), where she intended to explore how her studio created a platform for various ways of life, not only their own or a generic idea of living. Her studio started building a chart of emotions and activities of a house reflecting upon how space can represent communion between the occupants of a household (Figure 2). They put various images that represented their ideas and the collage started to form. Then they intentionally collaged six 'moments' of the house, with images commonly found. When they had the six collages (Figure 3), the studio collaged them all collectively and began sketching on them (Figure 4). This way, the collage became 'an incredible tool for design with a lot of meanings' for Bilbao's studio. She elaborated that a collage allows several notions to be in one space.
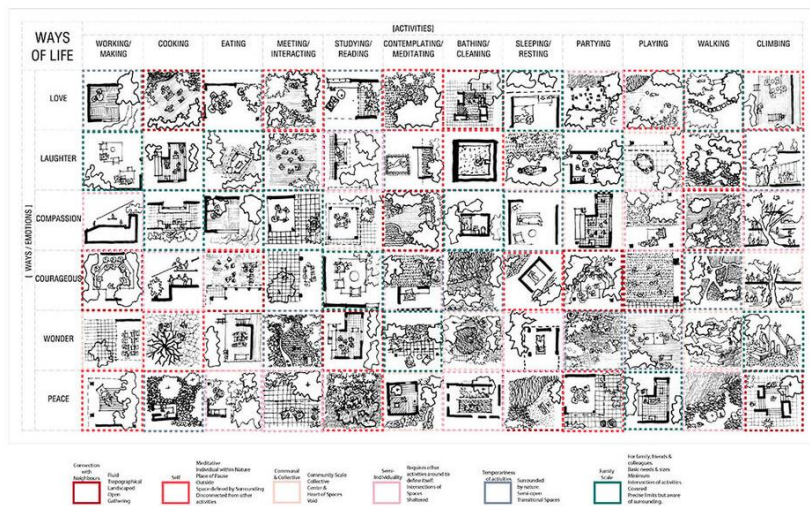
**Figure 2.** Process collages - Activities and Emotions, a compilation of many different moments of a house
**Note:** Reprinted with permission, courtesy Tatiana Bilbao Estudio, project Ways of Life
https://tatianabilbao.com/projects/ways-of-life/

In the project "Ways of Life", the first six collages (Figure 3) show users engaging in daily activities within the enclosed spaces or outside, blurring the boundaries and bringing nature within highlighting the context. They communicate the architect's intentions of creating multiple levels, exploring different forms and materials with the play of natural light. The compilation of the six images (Figure 4) retains the essence of the process and gives a further direction toward the crystallisation of the forms and spaces. Bilbao's process of collaging appears incredible due to its complexity of addressing several different emotions and their connection with spaces; yet, when the creation of collage is deciphered, the reasoning behind the design decision-making becomes evident.
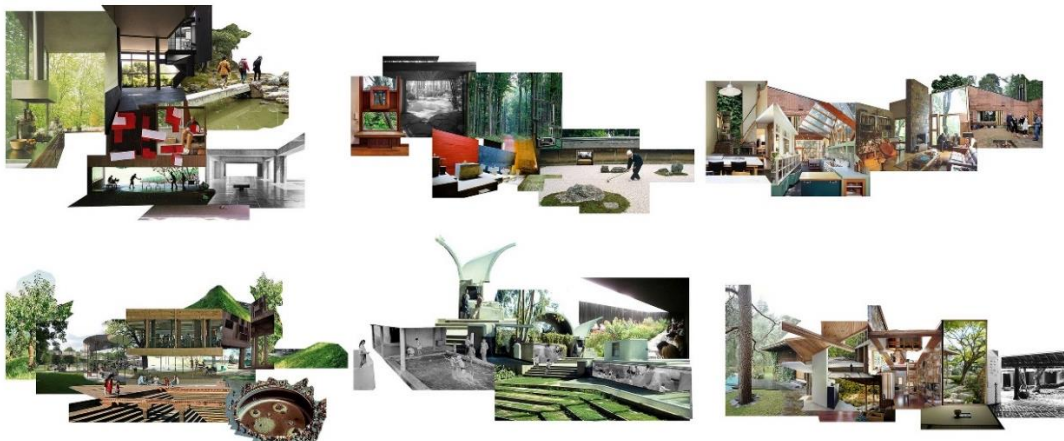


**Figure 3.** Process collages (6 collages in no particular order)
**Note:** Reprinted with permission, courtesy Tatiana Bilbao Estudio, project Ways of Life
https://tatianabilbao.com/projects/ways-of-life/

**Figure 4.** Process collages: Agglomeration of 6 collages (Figure3)
**Note:** Reprinted with permission courtesy Tatiana Bilbao Estudio, project Ways of Life
https://tatianabilbao.com/projects/ways-of-life/

In the Chicago Architecture Bienniale - Sept 2017- Jan 2018, Bilbao presented her concept of a skyscraper through her project titled '(Not) Another Tower' which sought to answer the requirements of the huge housing demands in a dense urban fabric. In this, Bilbao uses collage as a tool for collaboration between fifteen architectural studios to propose a vertical development that stands for connections with neighbours while preserving the identity, privacy and the essence of communal residential living (Figure 5). The 15 studios had their own unique vision for their part of the design, subsequently they collaboratively stitched together their work in the form of a collage that resulted in a vertical sculptural mass while creating a three-dimensional matrix of possibilities.



**Figure 5.** Vertical skyscraper, a collaborative collage
**Note:** Reprinted with permission, courtesy Tatiana Bilbao Estudio, project (Not) Another Tower Chicago Architecture Biennial, Photo credit: Steve Hall
https://tatianabilbao.com/projects/not-another-tower-chicago-architecture-biennial

Bilbao has creatively explored the potential of collage in the project, '(Not) Another Tower'. It is intriguing as though it stands for the work of fifteen different practices, it exhibits the core values of collaging, where collectively the vertical mass appears to be in sync with the concept of communal living (Figure 5). The collages show repetitive architectural elements, integration of nature, a sense of openness and reflection of

aspirations of the people that sing in unison in the sculptural skyscraper while showcasing various possibilities of urban living. Bilbao has succeeded in developing theories related to the possibilities of a project, different ways of representing them and including users to build further narratives.

## 3. Collage and Critical Thinking

Perry (1981) and many other cognitive psychologists linked critical thinking with 'reflective judgment'. Several researchers have opined that it is based on intelligence, logical thinking and problem-solving (Rimiene, 2002). Ennis (1989), Paul (1997) and other researchers developed critical thinking concepts and evolved their definitions. For Ennis (2011), critical thinking is a rational thought process focused on determining what to believe or do. Wehmeyer (2021) describes the collage as a critical image that leads the recipients to original understandings into knowledge through confrontation, rational analysis and personal experiences. This calls for thought processes outside the visual, written and temporality and for connecting one's position and action to the surroundings and people, concerning their past, present and future (Wehmeyer, 2021). Schon (1991) observes an architect's process of sketching and designing as a 'reflexive process' that slows down the drawing to add thoughtful responses. Collage has a similar deceleration effect; additionally, during the process and later, it provides an opportunity to detach oneself from the work to examine, compare and reimagine concepts and creations (Wehmeyer, 2021).

Schon (1991) portrayed the design process as iterative development phases where analytical, reflective and unreal activities are mutually connected and repeated. This can be compared with the process of collaging as a complex and ordered iterative process of layering that thrives on critical thinking. In 1990, Facione defined critical thinking as a cognitive process, an intentional self-regulatory resolution having two components: cognitive skills i.e. interpretation, analysis, inference, evaluation, explanation and self-regulation and a motivational factor i.e. the disposition toward critical thinking (Facione, 1990; 2011). Critical thinking includes a self-adjusting, self-monitoring and self-judging process while using cognitive skills. The successful application of these processes thrives on the holistic thinking of the context, criteria, methods and theories related to a given problem. Facione (2000) elaborates that the disposition towards critical thinking can be developed through good habits by striving to be inquisitive, methodical, judicious, logical, truth-pursuing, open-minded and confident in reasoning. Conscious efforts need to be made to achieve these dispositions among students to make them better problem solvers. The core critical thinking skills can very well be compared with the process of collaging and these cognitive processes highlight collage's ability to help in critical thinking, problem-solving and giving further direction to design.

### 3.1. Discussion on Critical thinking skills and Collaging

In the following table, the left side shows, core critical thinking skills, description, and subskills reproduced from the expert consensus Delphi report of 1990. The American Philosophical Association sponsored this research project involving 46 educationists including Facione and the report is the result of two years of their work. The left side also includes a part of Facione's further research (Facione, 1990; 2015). On the right side, the skills are connected with the collaging process concerning Architecture or Interior architecture (Space) Design.

**Table 1.** Comparison of critical thinking skills with collaging

| Core Critical Thinking Skills (Facione, 2015) Experts' Consensus Description | | | Drawing a parallel of critical thinking skills with collaging to explore how it applies in the collaging process of Architecture /Interior Space Design conceptualisation (Author) |
|---|---|---|---|
| **Skill** | **Description** | **Subskill** | |
| **Interpretation** | *"To comprehend and express the meaning or significance of a wide variety of experiences, situations, data, events, judgments, conventions, beliefs, rules, procedures, or criteria"* | *"Categorize Decode significance Clarify meaning"* | At the beginning of a collage in space conceptualising process with a site and design brief, interpreting data including criteria related to the context, climate, ethnographic study, identifying user needs, design parameters like style, materials, textures and structure, scale and proportions, inclusivity, sustainability, ergonomics, temporality, comprehending various situations etc, and decoding their significance. |
| **Analysis** | *"To identify the intended and actual inferential relationships among statements, questions, concepts, descriptions or other forms of representation intended to express belief, judgment, experiences, reasons, information or opinions"* | *"Examine ideas Identify arguments Identify reasons and claims"* | Examining the intuitively generated concepts or ideas, understanding the relationship of various design parameters; identifying implicit meanings in the images; identifying the most appropriate design responses to the interpreted data for selecting and eliminating certain images for layering; making the collage composition while focusing on metacognition, and consciously analysing the reasons in decision-making while layering. |
| **Inference** | *"To identify and secure elements needed to draw reasonable conclusions; to form conjectures and hypotheses; to consider relevant information and to reduce the consequences flowing from data, statements, principles, evidence, judgments, beliefs, opinions, concepts, descriptions, questions or other forms of representation"* | *"Query evidence Conjecture alternatives Draw logically valid or justified conclusions"* | In the process of layering, drawing reasonable conclusions about how the visualisation of the desired space should form, drawing conjectures from the fragments of selected images to form inferences and questioning alternatives of the design visualisations, forming hypotheses about the desired collaged space, concluding into the portrayal of a coherent spatial visualisation. |
| **Evaluation** | *"To assess the credibility of statements or other representations that are accounts of a person's* | *"Assess credibility of claims, Assess the* | Evaluating the outcomes of layering, assessing if desired parameters interpreted earlier, are portrayed through the various layers, examining |

| | | | |
|---|---|---|---|
| | *perception, experience, situation, judgement, belief or opinion and to assess logical strength of the actual or intended inferential relationships among statements, questions or other forms of representations".* | *quality of arguments that were made using inductive or deductive reasoning"* | the appropriateness of the location of varied images of the layers, judging if chosen images contradict each other or are consistent with the design vision, creating iterations to evolve better meanings; metacognition about roles of users' and viewers' perceptions, experiences and judgements and questioning if the resultant outcome is collectively generating the spatial experience intended. |
| **Explanation** | *"To state and to justify that reasoning in terms of the evidential, conceptual, methodological, criteriological and contextual considerations upon which one's results were based and to present one's reasoning in the form of cogent arguments"* | *"State results Justify procedures Present arguments"* | The resultant collage portrays the aesthetics of spatial visualisation with various design parameters judiciously exhibiting their interrelationships. The collage as an outcome stands for explanation and justification of decision-making; yet, it varies from any other forms of representation, due to its innate ability to invite the viewers to engage in deciphering the meanings, where the meanings may change as per the viewers' perceptions; therefore, the resultant explanations may have multiple meanings. |
| **Self-regulation** | *"Self-consciously to monitor one's cognitive activities, the elements used in those activities and the results educed, particularly by applying skills in analysis and evaluation to one's own inferential judgments with a view toward questioning, confirming, validating, or correcting either one's reasoning or one's results"* | *"Self-monitor, Self-correct"* | In the case of a collage, focussing on metacognition, self-monitoring or self-correcting processes leads to further investigations or evolving into further iterations of collages, refining the design process, adding to previously created outcomes and leading to explorations of further design directions. Self-consciously monitoring the metacognition through the entire journey of collaging and reflecting upon it results in building confidence in one's own decision-making. |

**Note:** Facione, P.A. (2015). Critical thinking: What it is and why it counts. adapted from: Insight assessment p. 10., APA Report: Expert Consensus Statement on Critical Thinking. (ERIC ED 315 423). The right column presents analyses by the author connecting collaging to critical thinking

## 4. Experimenting with collage in the Interior Architecture (Space) Design Studio for concept development

One section having 30 students of the 3rd-year undergraduate Design Studio of Space Design discipline at a University, in Ahmedabad, India explored reimagining a large space of a mall abandoned during Covid. The Space Design program has commonalities with a typical Interior Architecture program, yet it also focuses on developing an understanding of Architecture, Urban Design, Landscape, Exhibition Design, etc. The studio attempted to envision this space as a place for well-being that would cater to the residential neighbourhood nearby. The abandoned mall's unique

location at a busy intersection posed the challenge of achieving a peaceful environment within the interior spaces while encouraging users to work on their fitness through various activities.

Students began the project by developing an understanding of well-being in the urban realm, analysed the site and evolved their programmatic response appropriate to the site context. They further studied the existing structure and explored the space modulation through volumetric zoning in physical models. After this stage, the students were working on developing concepts but they began to struggle with creative ideas. Karassowitsch (2019) argues that creativity has a foundation of lived experiences and cognitive schemas and thrives on refinement, adaptation, reconfiguration and transformation of existing knowledge. Oktan and Vural (2019), mention that in conventional design educational institutes, physical model-making is only used to see visual manifestations of the designs and therefore, there is a need to use more exploratory tools that lead to multiple design possibilities and provide future design directions. Therefore, collage was introduced in concept designing when students felt stuck.

Karassowitsch (2019) indicates that the solution-oriented design approach in a design studio often relies on prior knowledge of the faculty, resulting in student dependency; therefore, focus must be given to enhancing student's cognitive abilities. Our introduction of collage was an exploratory approach and the students were asked to pay attention to their metacognition as they had to make decisions regarding various design parameters like the site context, space modulation, scale, proportions, user needs, structure and materiality, colours, textures,  light, ventilation, etc. The first attempt at space design through collage-making appeared like a mood board of different inconsistent images, due to the students' earlier ways of working and did not create a visualisation of a space, clearly showing a need for more thinking. Therefore, the students were asked to make another iteration where, while identifying various layers of collage, they were expected to think critically about the different design parameters and make decisions focusing on metacognition attempting to visualise a coherent space.

### 4.1. Survey and interview methods

A survey was conducted using Google Forms and the technique was convenience sampling as students were asked to participate voluntarily and 25 of the 30 filled out the survey forms. Randomly selected 15 students were also interviewed in-person and online and their responses were recorded. The hypothesis for this exercise was that the students learn more effectively and think critically during conceptualising when digital collaging and physical model-making are combined. The research question was how the collaging process helped students think critically and make design decisions during the concept development. Survey objectives included making students decelerate during collaging to focus on metacognition, further reflecting on their design process, establishing the effectiveness of collaging and reviewing the quality of outcomes of the collages. The broader questions related to collaging and metacognition included:

Have you used collage before? Do you prefer digital collaging or physical?

How did physical model-making help you in the design process?

How has collaging helped you in the design process concerning specific design parameters?

Were you able to consciously focus on your own thought process while collaging?

Do you think collaging effectively contributed to your design process? If yes, in what way?

Do you think that collaging helped you in critical thinking and decision-making?

How do you compare the effectiveness in decision-making of the tools of collaging, physical model making and rendering?

Will you use collage again and why?

### 4.2. Survey results of critical thinking during collaging

Students were told to reflect upon the process of collaging and identify connections with design decisions during conceptualising. 44% of the students had never used a collage earlier in the design studio; therefore this was their first experience of using collage in space design concept development. 80% of the students preferred making a digital collage over a physical collage. To understand students' stand on physical model-making, they were asked how the process had effectively helped them. 64% thought that physical models effectively helped in the understanding of scale, proportions and visualisation of space modulation, 64% thought they understood the structural system clearly; whereas 36% mentioned that they felt stressed during the physical model-making as it took too much time. When asked how collaging helped, 62% mentioned that it helped them think about materials and textures, 66% mentioned that it helped in the visualisation of colours and more than half of the students found collaging exciting as it worked better to make quick decisions as they could quickly view the results of visualisations. For 70% of students, both processes gave different perspectives and they collectively helped them develop concepts.

Students were told to rate the effectiveness of collage on a scale of 1 to 5 (5 being extremely effective). Over 90% of students rated collage's effectiveness between 3 and 5 for the design parameters of context, users, space design language, sense of scale, space modulation, structure and materials, visualisation of the space, design continuity and creativity. Further, the questions focussing on different critical thinking skills as pointed out by Facione, were also asked to understand if students comprehended the process of collaging and its connection with critical thinking. For each of the skills of Interpretation, Analysis, Inference, Evaluation, Explanation and Self-regulation, the students seemed to have unified opinions. All students who participated in the survey rated the effectiveness of collaging to think critically between 3 and 5.

To understand students' thinking and opinions regarding the collage and critical thinking, 15 students were interviewed online as well as in person and recorded. They mentioned collaging made them consciously focus on their thought process and identify reasoning while layering. It effectively contributed to their design process due to the collage's ability to have multiple interpretations as the faculty comments interpreted certain strengths in their design that the students themselves had not initially imagined. They mentioned it succeeded hugely in expressing materiality and the design language. They think this is far better than creating a mood board typically created in interior design as it is integrated into the space visualisation. They all mentioned that they enjoyed collaging due to its ability to manifest quick visuals and abstract representations. They thought it helped them in critical thinking as their design decision-making improved with selecting images for layering and reasoning for the selection with each iteration. All students who explored collage mentioned they would like to use it again during concept designing for quick visual manifestations of spaces.

**Figure 6.** Students' work- collages showing space visualisations during conceptualising
**Note:** Images courtesy students of Section B, batch of 2021, Space Design, Anant National University

## 5. Discussion on linking collage with critical thinking through mixed methods:

The literature highlighted how collage represents a state that is neither real nor abstract and initiates a new, theatrical perception having immense narrative possibilities (González-Jiménez & Enia, 2023) due to its inherent nature of being open to interpretations. This invites viewers to create multiple meanings and prompts the quest to understand the process of layering and collaging. This further connects decision-making while layering and its links with critical thinking. According to the Delphi report, different critical-thinking skills lead to thoughtful judgement and reflective problem-solving and the disposition for it is based on the critical spirit that involves having the dedication to probing, finding reliable information through questioning, reasoning and assessing the outcomes (Facione, 2000; 2011). The collaging process also fosters the integration of mutually supportive, intuitive and reflective decision-making.

Tatiana Bilbao's way of collaging in her design practice brings forward her philosophy of utilising the collaborative and open-ended nature of collages over realistic renderings. Her design progress is evident through the multiple iterations of collages. In Ways of Life, understanding the activities and emotions (Figure 2) and compiling them in a collage (Figure 3) to relate with each other and decipher design directives for required spatial configurations pushes the boundaries of critical thinking and leads to creative yet deliberate design decisions. Each further iteration of the collage slows down the design process giving time to reflect. Putting the collages together into one collage and drawing over them allows one to identify critical and beneficial design elements, analyse them, understand their significance and conclude what needs to be taken further in design development. In (Not) Another Tower (Figure 5), as the whole design is an assemblage of different design compositions, it stands together as a vertical 3-dimensional collage. It invites viewers to deliberate on the multiple iterations and thought processes that may have led to the resultant sculptural mass showcasing further design directions due to its open-ended qualities. Therefore, Bilbao's collaging showcases how collage can advocate critical thinking.

The design studio experiment liberated the students from previous habits of depending on faculty for further instructions in design development. The digital collaging

method provides the freedom to select images and continue viewing the abstracted space visualisations. The search for appropriate images empowers the students with tools to investigate initial design parameters and ensure that the resultant visualisation exhibits their conceptual ideas in the best possible manner. In contrast to realistic renderings, where students get restricted by visualising forms and structures that are easy for 3D modelling, collaging provides a liberated way of thinking, representation and unrestricted possibilities. The combination of tactile physical model-making with virtual digital collaging effectively displayed how students could think critically, make design decisions and understand further steps of their design evolution.

### 5.1. Study Limitations and Further Research Directions:

The study is limited by the ability of students to reflect on the researcher's questions and their personal opinions as per their varied backgrounds. Studio experimental study is limited to the combination of digital collaging and physical model-making but does not include other tools like physical collaging, realistic rendering, AI image generating, etc. The comparison with different tools was not done due to several variables in the design process in academic studios. Further research may explore such tools and compare their effectiveness in critical thinking for space design.

## 6.   Conclusions

Architectural and interior space design education constantly needs innovative pedagogies to make students better critical thinkers and problem solvers. In this quest, collage as a tool needed exploration for its collaborative, iterative, narrative, open-ended and viewer-participatory qualities that empower the creator to think critically for effective decision-making. The different processes of collaging and the core critical thinking skills of interpretation, analysis, inference, explanation, evaluation and self-regulation portrayed by the Delphi Report of 1990, exhibit significant correlation.

Therefore, in the concept development process of the Space Design Studio exercise, collage was used to verify that students learn more effectively when digital collaging is combined with physical model-making. This process helped the students quickly visualise their ideas to make decisions concerning various design parameters and analyse the resultant design language that provided further design directions. Collage has enriching potential for reflection and communication. The design studio experiment proved that collaging, focusing on metacognition, was very effective as a critical thinking tool. The students were empowered independent thinkers as they could see further design directions. This article clearly shows various tenets of using collage in practice and academics and contributes an approach that focuses on critical thinking for better decision-making to achieve better quality designs. Therefore, during conceptualising, collage as a tool for critical thinking has immense potential in achieving design quality excellence in academia and practice.

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