IHIET 2024

11th International Conference on Human Interaction & Emerging Technologies: Artificial Intelligence & Future Applications

April 25-27, 2024, Centre Hospitalier Universitaire Vaudois (CHUV), Lausanne, Switzerland

How can physical studio space integrate and support speculative AI design experimentation and visualization workflows?

Silvia Albano[1] Deborah Middleton[2] GianMarco Longo[3]

Xi'an Jiaotong-Liverpool University
西交利物浦大学

ANTHONY MCCALL, 5 MINUTES OF PURE SCULPTURE - light installation, NY, 2012

Abstract

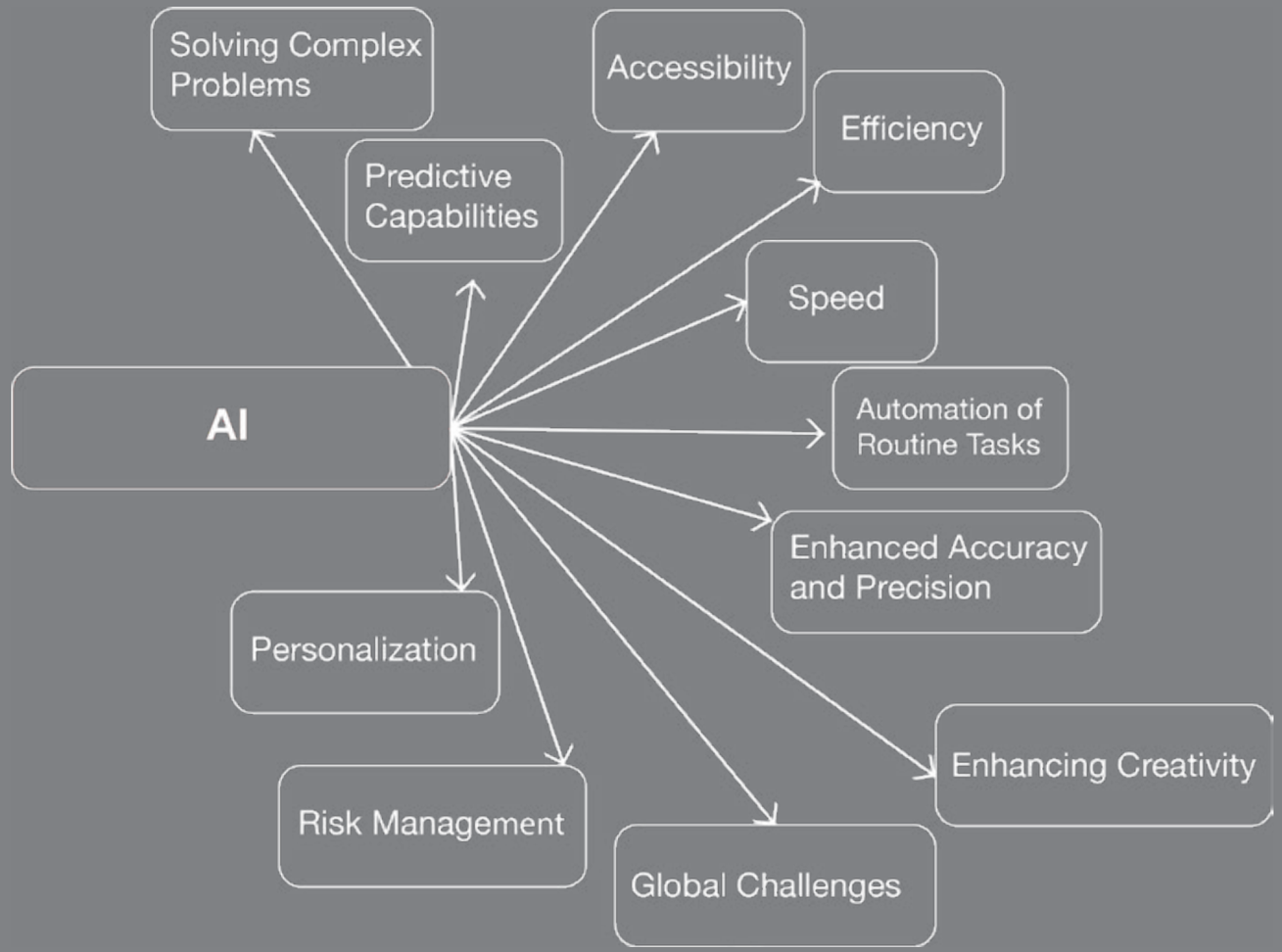


Fig.1 AI as a tool benefits

Today there is no doubt that the helpfulness of AI stems from its ability to increase human capabilities, making it possible to achieve more than human beings could accomplish alone.

Its adaptability to different applications and industries makes it a powerful tool for innovation and improvement.

Through deep analysis, this paper highlights how thoughtful physical space configurations, during a series of pre-structured activities, enhance designers' productivity, social collaboration and interaction and achievement of desird outcomes.

Keywords:
Space configuration, Artificial Intelligence, user experience, workflow, visualization,
speculative design

Table of contents

1 Introduction

2 Workshop Workflow ..... Framework for design process, physical space and virtual outcomes

3 Methodology

4 Analysis and findings ..... Role played by physical configurations of space. Interactions of environmental quality (daylighting).

Social interactions with physical space and workflows.

Spatial configurations to support the design framework.

Configuration of co-visibility (VGA) analysis Space Syntax.

5 Conclusion

6 References

Introduction

This study investigates the influence of physical workspace, environmental quality, and social interactions on the facilitation of design processes. The genesis of this research can be traced back to the insights and analyses derived from a workshop conducted at Xi'an Jiaotong-Liverpool University (XJTLU) in China. Named "The Quality that Lights Up," this workshop was a collaborative endeavor with two external stakeholders and served as a pioneering initiative aimed at envisioning the future landscape of lighting in the residential environment in a ten-year timeframe.

By integrating generative artificial intelligence (AI) in a two-phase approach—initially through a conceptual phase titled "Visions" followed by a pragmatic phase named "Solutions"—the project sought to chart innovative trajectories in lighting design.

The workshop was conceived by the Departments of Architecture and Industrial Design at XJTLU, designed as a pedagogical strategy to enrich students' understanding and expertise in the domain of lighting within the design spectrum.

Fig.2 Poster of the workshop: The quality that lights up!

Workshop Workflow

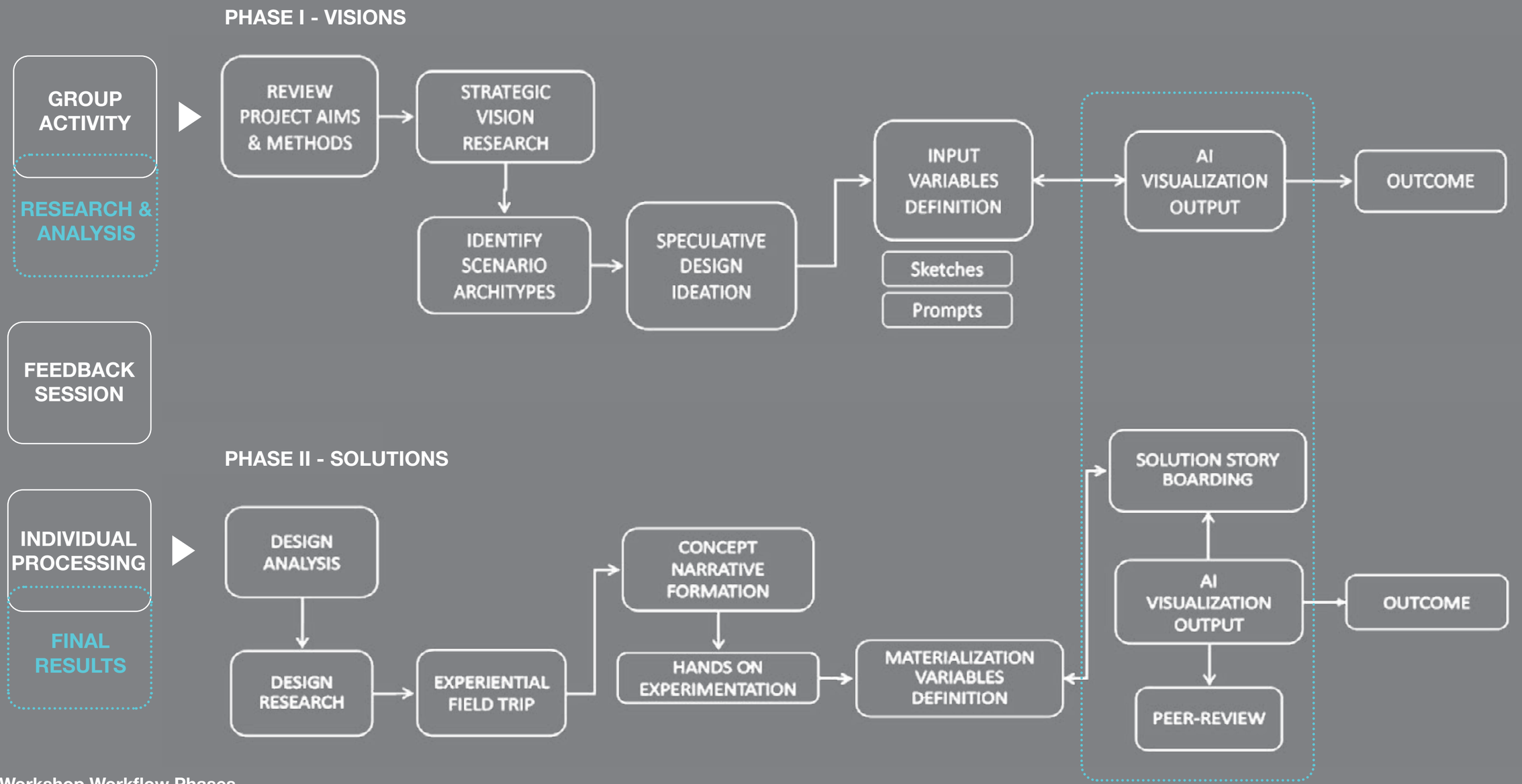


Fig.3 Workshop Workflow Phases

Workshop Workflow

In the 1st phase, participants engaged in pre-arranged tasks such as hand sketches, trend research, and lighting experiments within a speculative design framework, utilizing the Miro platform for collaborative brainstorming, which aimed at developing futuristic lighting concepts.

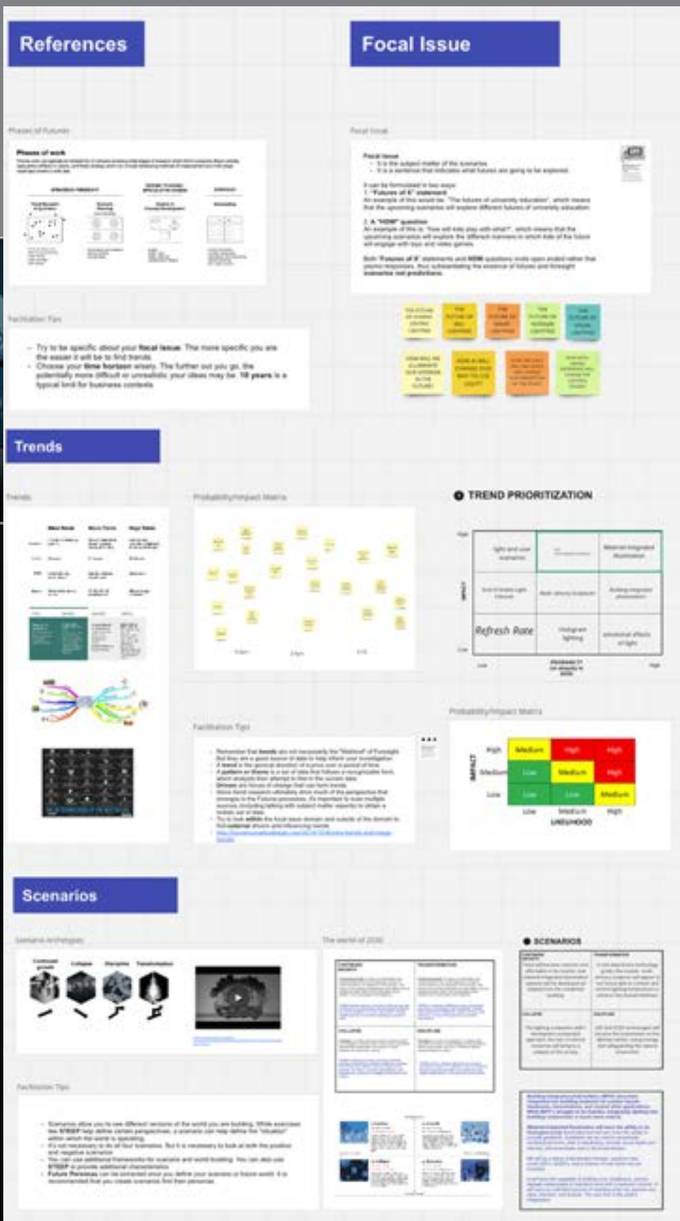


Fig.4 Group1 Trend research. Fig.5 Group1 Futuristic concepts. Fig.6 Miro speculative design framework phase I Vision

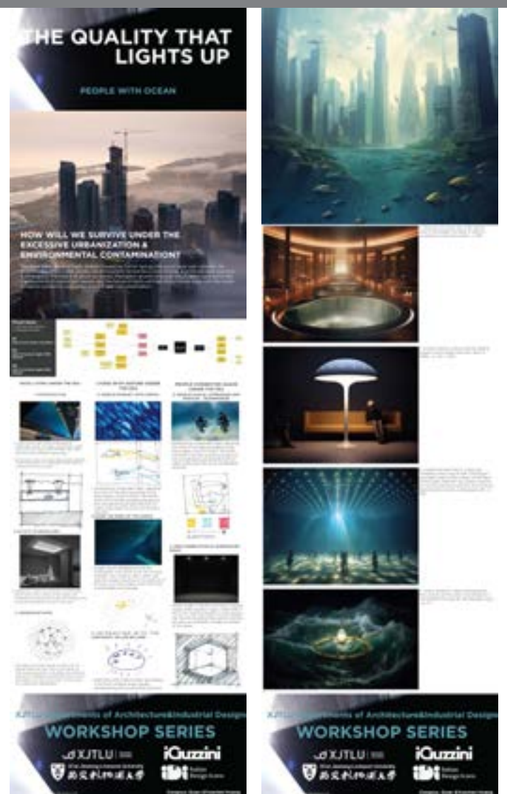
Workshop Workflow

Following the reception of formative feedback, the second phase focused on transforming these conceptual ideas into design proposals for future residential applications, emphasizing the creation of atmospheres rather than fully detailed projects. The workshop concluded with participants presenting their work in two parts: research and analysis documentation, and illustrations of their final individual design proposals, showcasing a blend of collaborative and independent efforts.

Fig.7 Group4 Feedback. Fig.8 Iconic Image by student Congruo Guan. Fig.9 Final proposal by student Congruo Guan.

iGuzzini Feedback

Very cool topic to explore human future habitat. Under the presumption of people being forced to live underwater, you guys managed to develop multiple circumstances of how people interact with the environment by using different light applications. Many of them are very imaginative. The final four proposals are very distinct. We are particularly interested in the first one. However unfair it might sound; deep-sea living is going to be a luxurious living experience. Even when everyone is forced to move under the sea only a minority of people will eventually get there. Leaving the moral issue aside, a premium spa venue is a very possible subject and a good hands-on experience for you guys to develop a more detailed lighting design project based on it.



Tutors Feedback

PEOPLE WITH THE OCEAN

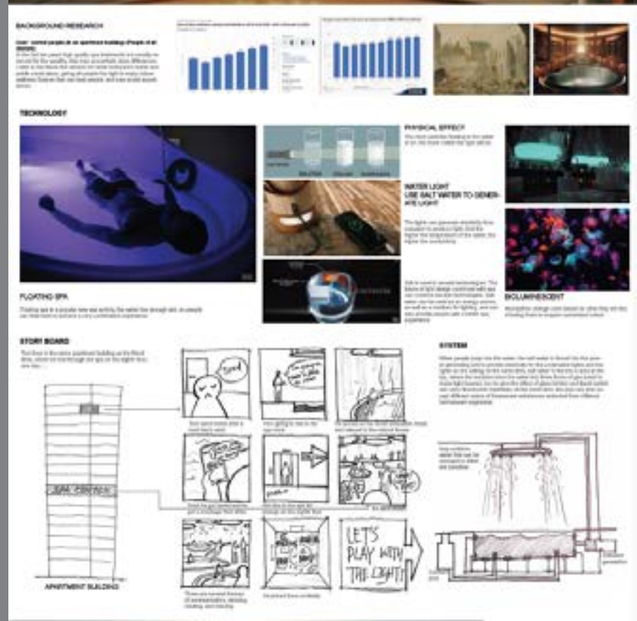
STUDY AND DEVELOP THE TOPIC:

FUTURE HUMAN HABITAT

- how people will interact with the environmentwith different light scenarios
- wellness architecture
lighting design in wellness as an immersive experience
- research on the global wellness trends
- urban bathhouses & wellness playground

(Affordable wellness into the residential context)

WELLBEING RESIDENTIAL PROJECT
REF. ATELIER SUL MARE - CASTEL DI TUSA, HAMMAM ROOMS...



Workshop Workflow

In the described workshop the design process was meticulously followed from discovery to implementation, emphasizing a deep understanding of project requirements, ideation through creative collaboration, and refinement of concepts with detailed feedback sessions. The physical workspace was dynamically configured to support creativity and practical testing, adapting to different times of the day and the speculative design process, thus enhancing the workflow. The integration of virtual tools like Miro, Vizcom, and Midjourney alongside spatial adjustments facilitated a consistent visualization approach, showcasing the significant impact of space and technology on the design outcomes.

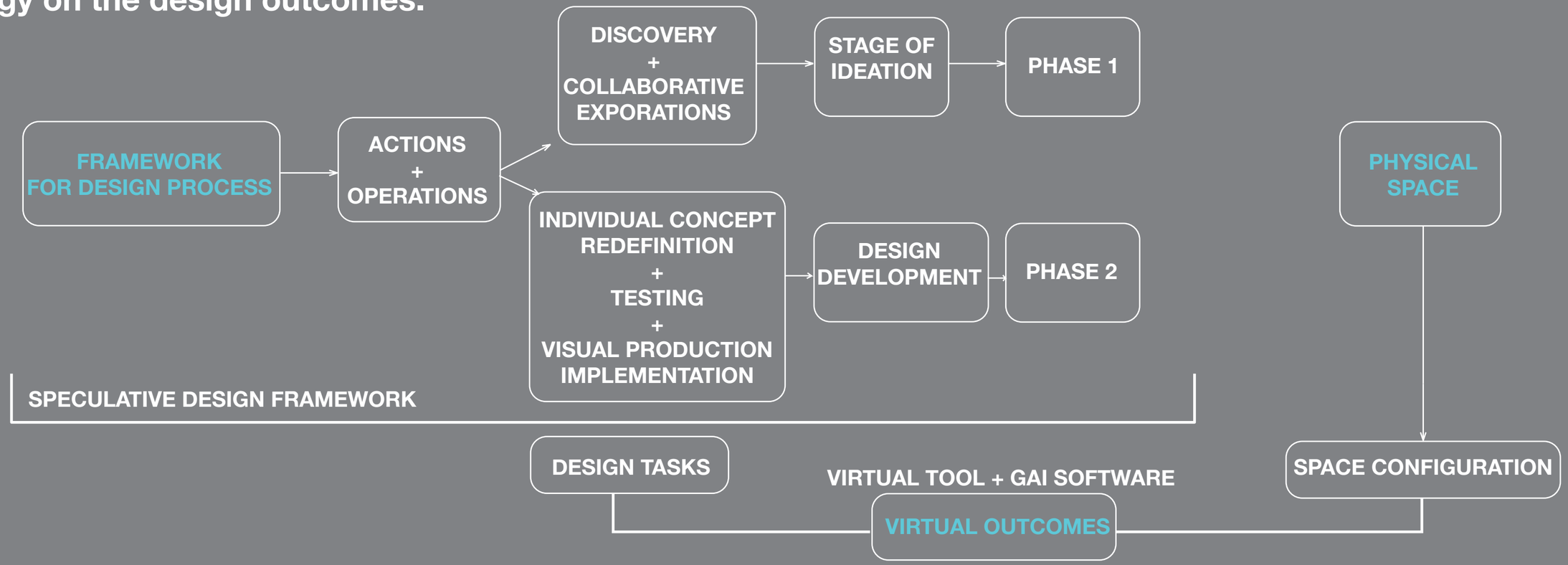


Fig.10 Framework for Design Process, Physical Space and Virtual Outcomes as three main components of the Workshop Workflow

Methodology

This paper explores how physical workspaces can be optimized for generative AI use in design practices, focusing on supporting collaborative interactions and dynamic visualization spaces.

Through qualitative methods of time-lapse photography and space syntax analysis, it investigates workspace configurations, social formations, and the interplay between visual displays and participant locations.

The study identifies typologies of visualization modes and examines the impacts of daylighting, furniture organization for social interaction, and spatial configurations on the design workflow, providing insights into enhancing Human-Computer Interaction (HCI) within design tasks.

Fig.11 Picture of one space configuration+activity - day 1 - phase 1

Research Questions

1) How can physical workspace support collaborative interaction and construct a dynamic space for design visualization?

2) How does the physical environment affect Human Computer Interaction (HCI) in the workspace?

Fig.12 AI Visualization by Xiaohe Wang - Final visual production - Phase 2

Analysis&Findings

The research findings are presented through a series of composite tables detailing how the physical studio space facilitated speculative AI design experimentation and visualization workflows.

This structured presentation aims to illustrate the dynamic interplay between physical space configurations, lighting conditions, and participant engagement in design tasks.

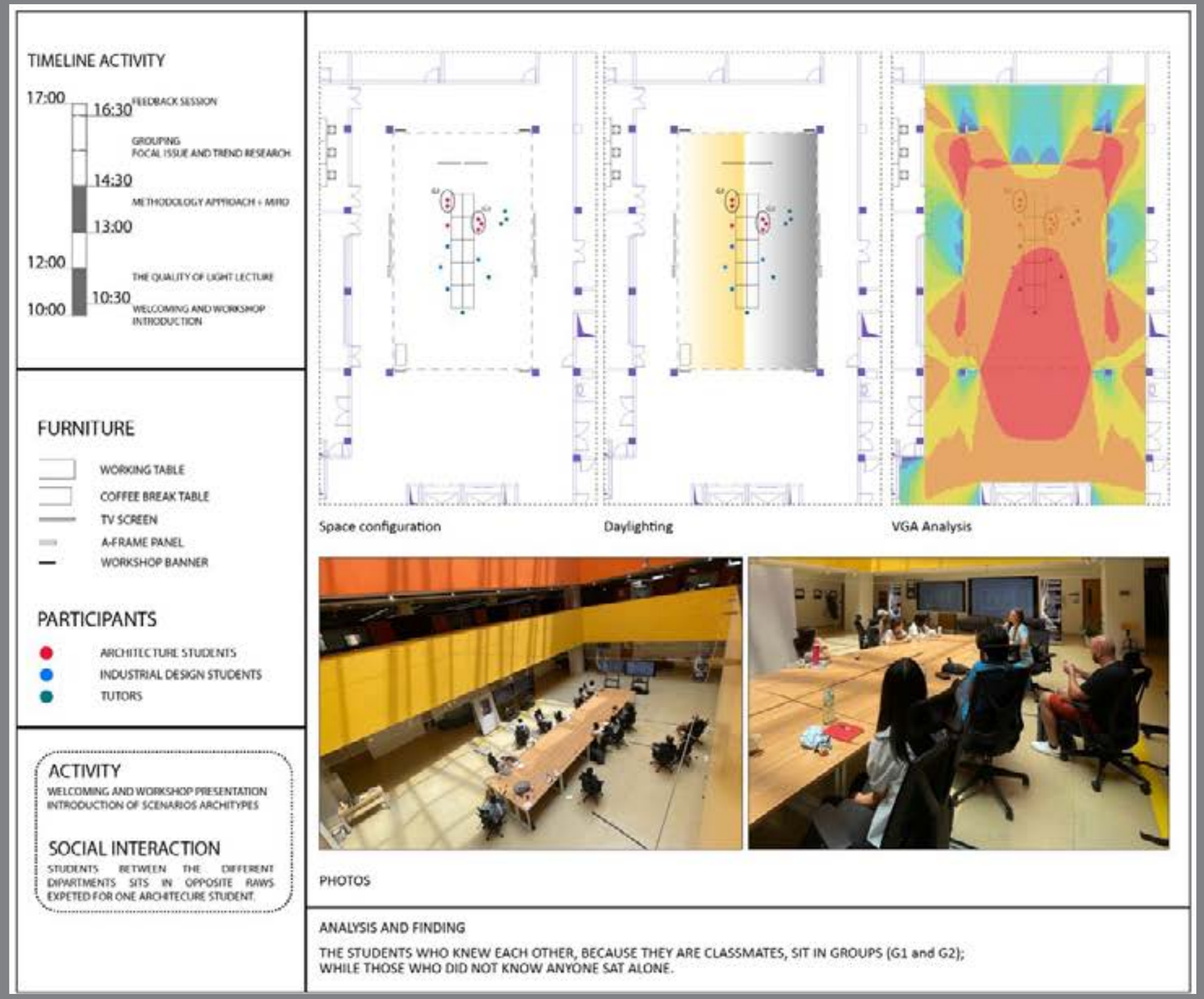
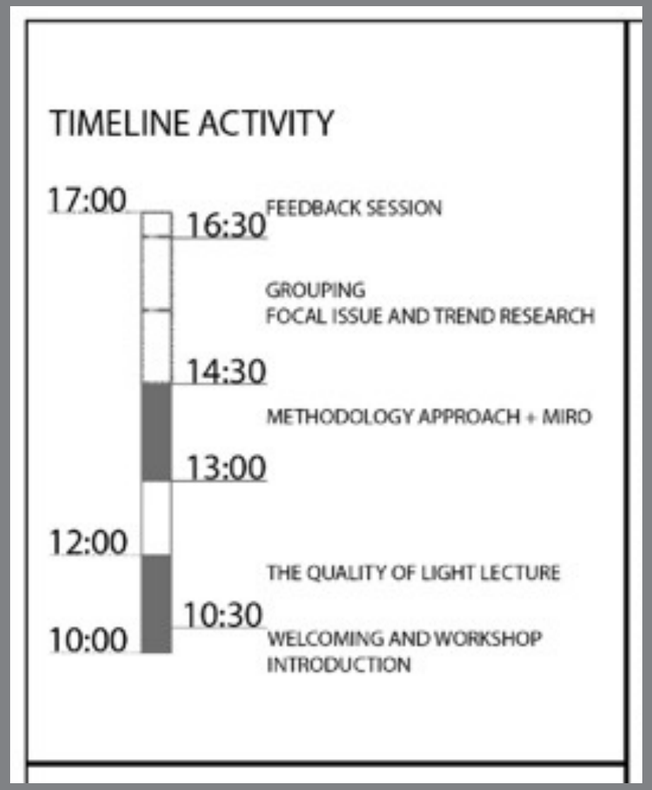
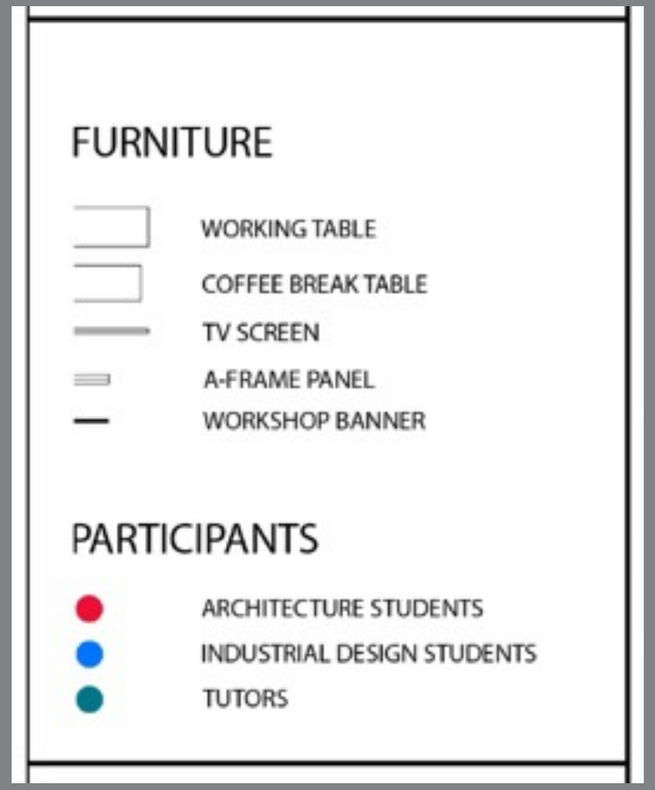


Fig.13 Composite Table1_Space configuration analysis activity 1.

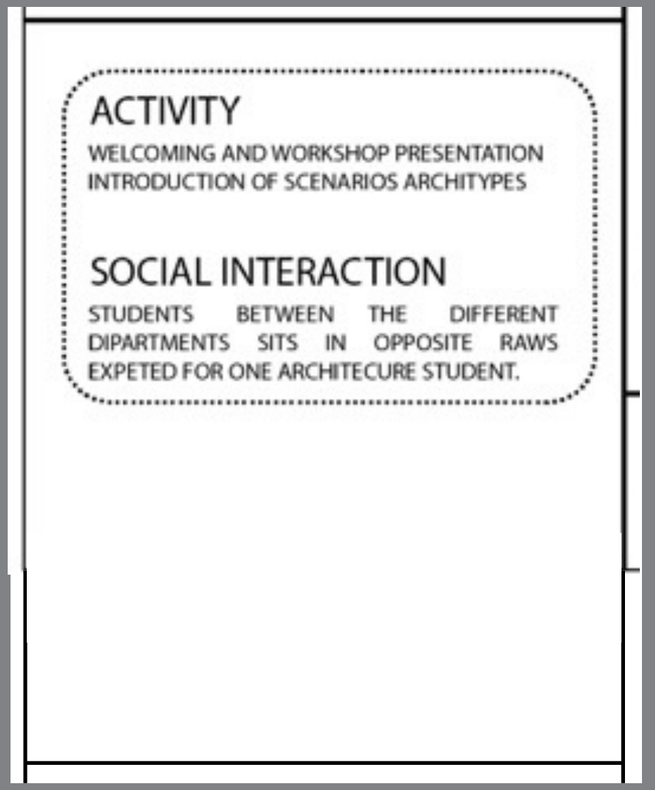
Analysis&Findings



A “timeline activity” bar on the left, showing task distribution across different hours of the day.



A legend for describing the furniture arrangements provided, and a second one for showing the participant involved.



At the end a brief description of the activity presented and the social interaction analyzed.

Fig.14 Composite Table1_Space configuration analysis activity 1 - close up on the left column.

Analysis&Findings

The central part of each table offers a tripartite graphic analysis covering space configuration, daylighting, and Visibility Graph Analysis (VGA), allowing for an understanding of space organization, lighting variations (highlighted through different gradients), and participant positioning (coded by color for different student groups) during activities.

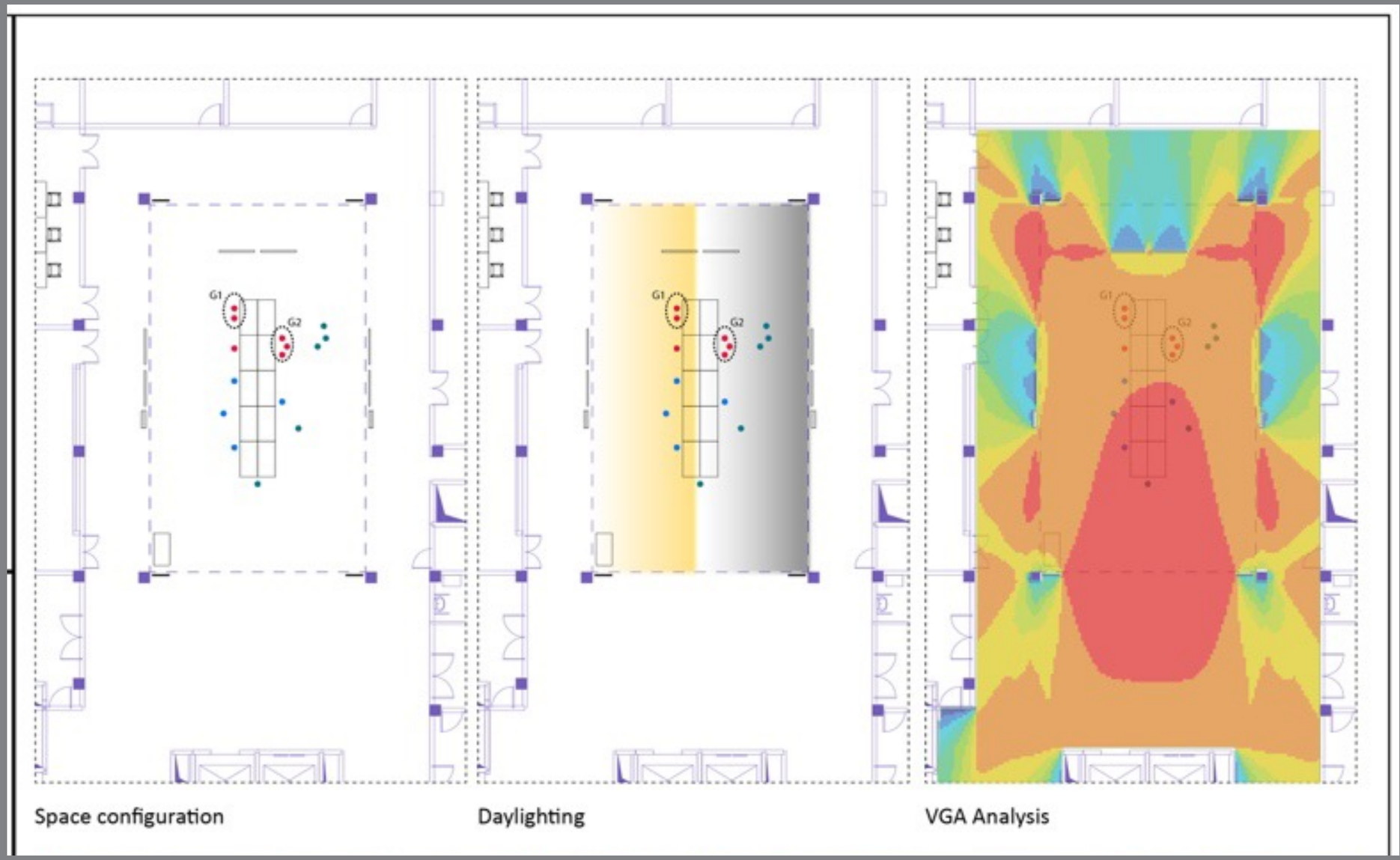


Fig.15 Composite Table1_Space configuration analysis activity 1 - close up on the central part.

Analysis&Findings

ROLE PLAYED BY PHYSICAL CONFIGURATIONS OF SPACE_INTERACTIONS OF ENVIRONMENTAL QUALITY (DAYLIGHTING)

This project emphasizes the critical role of physical space not just as a backdrop but as a dynamic factor enhancing the design process and workshop goals. Through various spatial configurations, the project fostered workflow efficiency and social interaction among participants. These configurations facilitated the creation of specific lighting atmospheres, enabling a reflective and iterative design process. The study critically assesses how the interplay between physical and virtual spaces creates a supportive environment for design. Adjustments to spatial arrangements were made with the objectives of fostering team interaction, controlling natural light to optimize digital screen visibility, and creating ideal conditions for reflecting on research topics, thereby informing the development of final outcomes.

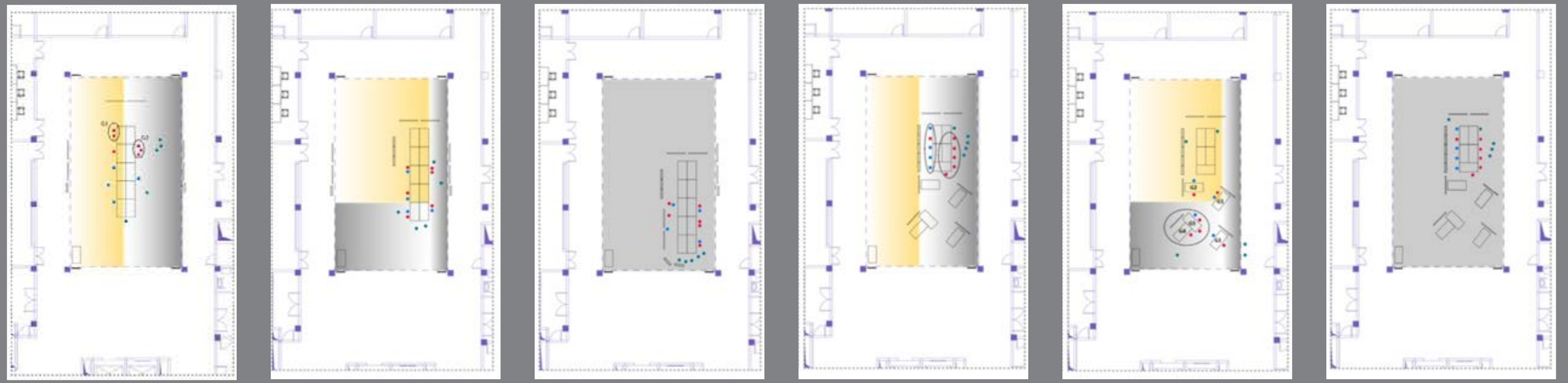


Fig.16 Close up on Daylighting analysis of Table1, 2, 3, 4, 5, 6.

Analysis&Findings

SOCIAL INTERACTIONS WITH PHYSICAL SPACE AND WORKFLOWS TO SUPPORT THE DESIGN FRAMEWORK

The study highlights the importance of physical space configurations in enhancing social interactions among de signers, integrating thoughtful layouts and the use of virtual tools like Miro. Open floor plans and communal areas promote community, spontaneity, and meaningful exchanges, while technology like interactive displays boosts information sharing and collaboration. Such environments encourage exploration, experimentation, and ideation, offering designers the freedom to envision alternative futures. Spatial arrangements facilitate dynamic teamwork, with examples of effective collaboration and creativity in configurations designed for various group sizes and in-ter-departmental cooperation. This approach supports speculative design processes, empowering designers to challenge norms and innovate for future scenarios, specifically in residential lighting design.

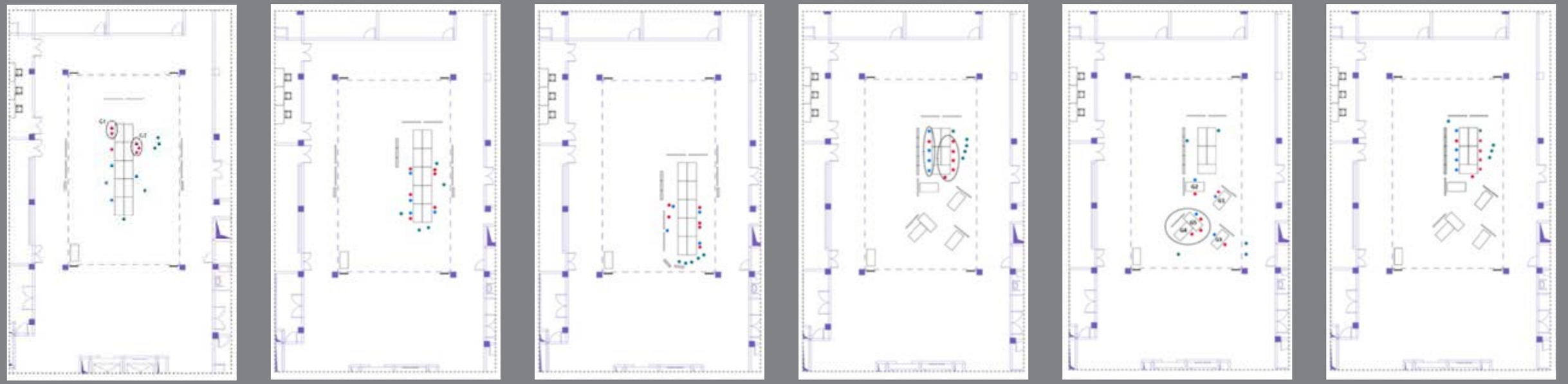


Fig.17 Close up on Spatial Configuration analysis of Table1, 2, 3, 4, 5, 6.

Analysis&Findings

CONFIGURATION OF C0-VISIBILITY (VGA) ANALYSIS SPACE SYNTAX

Using Depthmap software for space syntax analysis, this study explores how spatial configurations and visual displays interact with participant positions, identifying areas of co-visibility. The Visibility Graph Analysis (VGA) distinguishes the most integrated, visually permeable spaces in red, grading to the least permeable in darkest blue. This method reveals how shared co-presence around work tables evolves into focused workflows, with teams forming and utilizing shared and individual computing resources. As the workflow progresses, areas of limited visual connection signify concentrated team collaboration and knowledge acquisition activities. The transition from highly integrated to more localized visibility zones reflects adjustments in workspace configurations to foster closer communication and effective shared visualization, enhancing the collaborative design process.

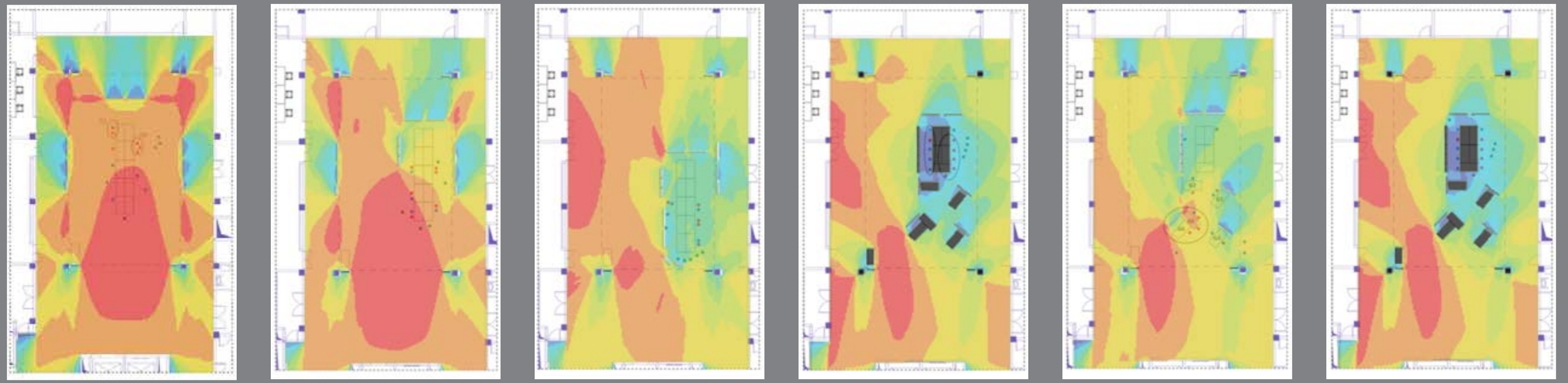


Fig.18 Close up on Visibility Graph Analysis (VGA) of Table1, 2, 3, 4, 5, 6.

Analysis&Findings

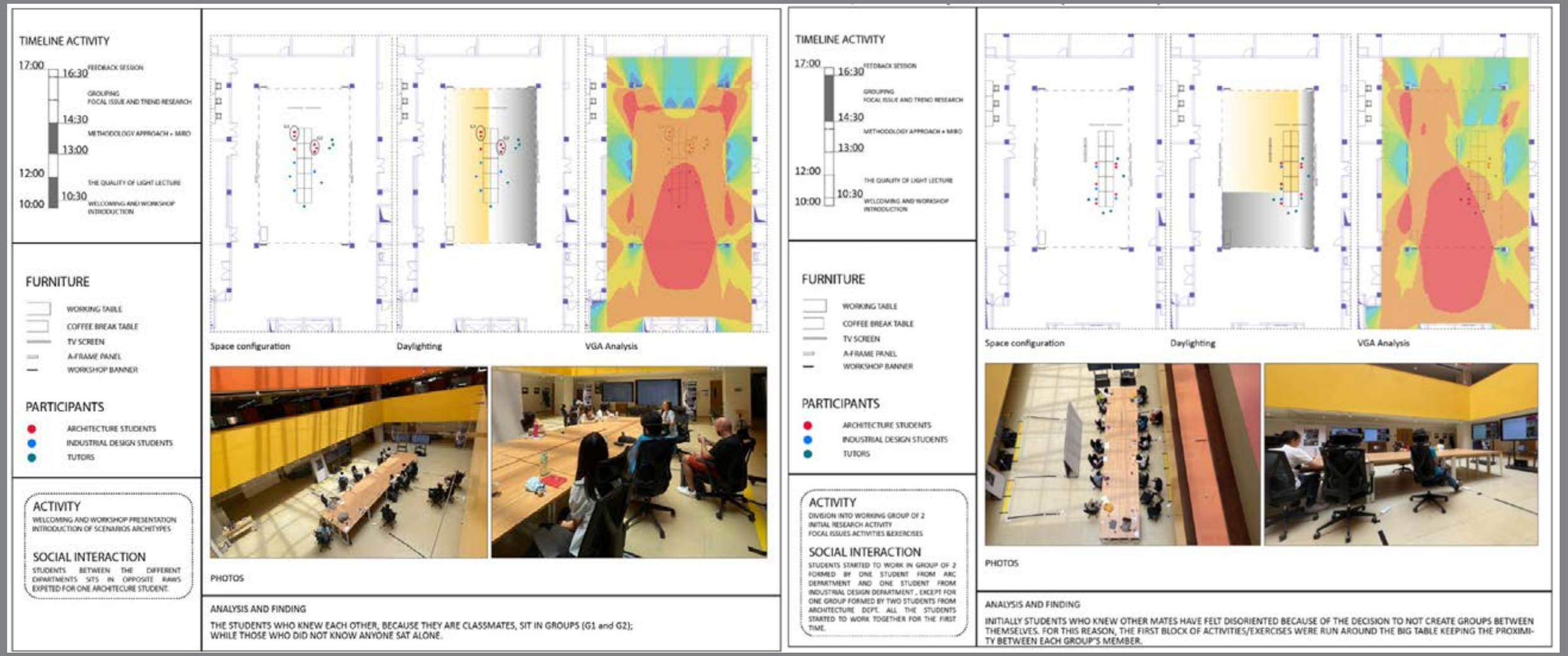


Fig.19 Compositive Table1 and 2.

Analysis&Findings

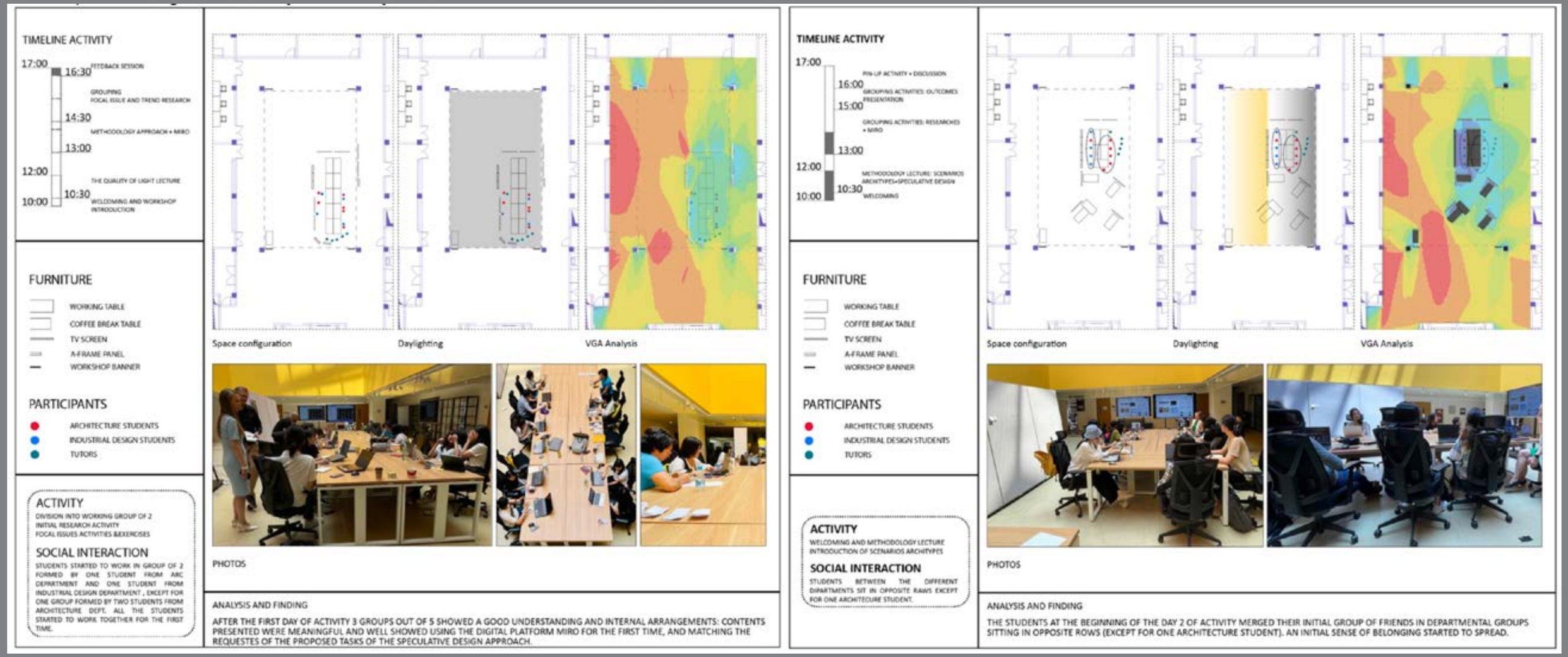


Fig.19 Compositive Table3 and 4.

Analysis&Findings

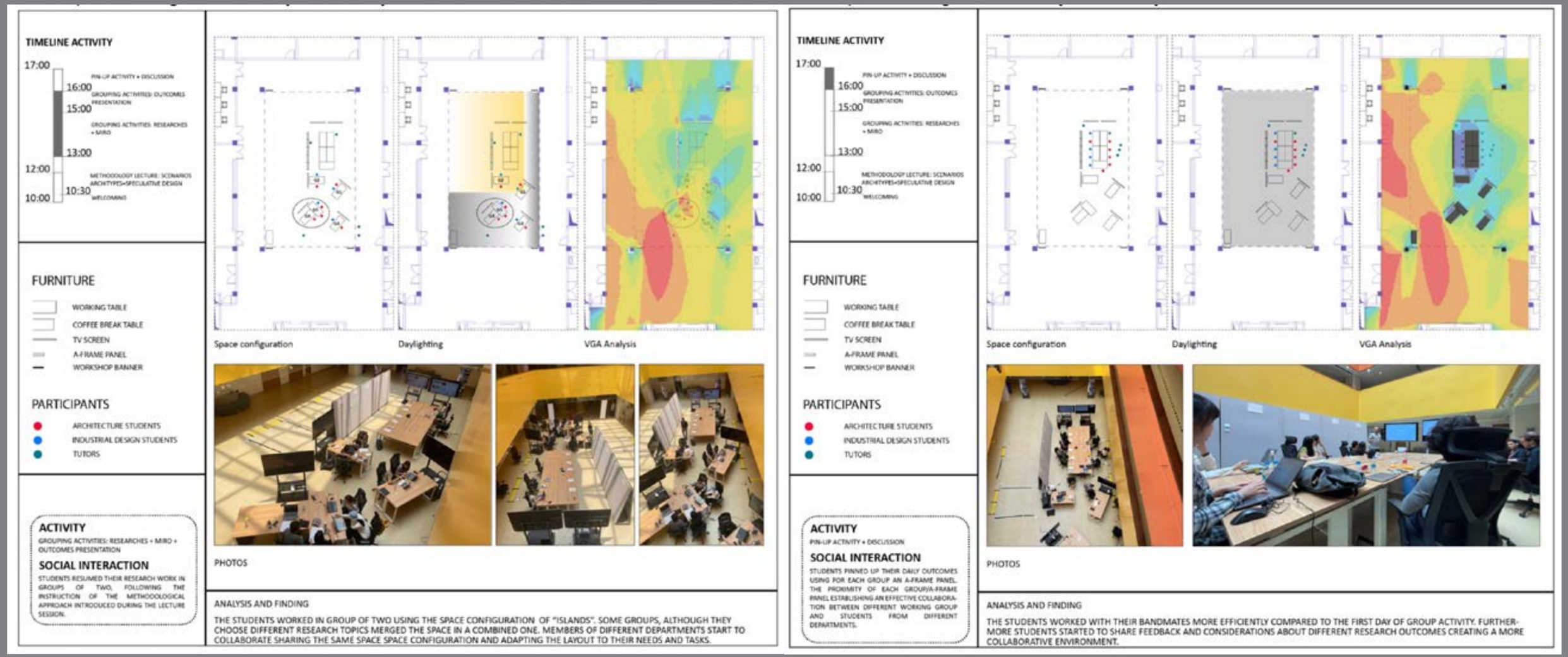


Fig.20 Compositive Table5 and 6.

Conclusions

Integrating speculative AI design experimentation and visualization workflows within arranged physical studio spaces significantly enhances the design process, blending physical and virtual environments to push the boundaries of creativity and innovation.

Such studio spaces facilitate collaborative brainstorming and experimentation, allowing designers to deeply engage with the speculative design process.

Tailoring these spaces with technology like large screens, projection systems, and interactive platforms enables designers to effectively represent and share their AI-driven concepts, facilitating communication with stakeholders and promoting iterative design improvements.

Fig.21 AI Visualization by Josiah Hariono Poedji - Final visual production - Phase 2

Conclusions

Moreover, these environments support collaborative knowledge-sharing, drawing on diverse perspectives and expertise from multidisciplinary teams, thereby enriching the design process.

This approach not only fosters creativity and skill development but also cultivates an innovative ecosystem that propels forward-thinking studies and the creation of impactful AI-driven design solutions.

The union of physical space and speculative AI workflows thus creates a dynamic setting that nurtures innovation and enhances design thinking, paving the way for breakthroughs in AI design.

Fig.22 AI Visualization by Lan Wei - Final visual production - Phase 2

References

Balagtas Phil 2019, Design Is [Speculative] Futures Design Thinking - a new toolkit for pre-emptive design. https://www.youtube.com/watch?v=UB9UVHGI6AI Accessed (6 November 2023).

IES Visionary Challenge, 2020 https://design.umn.edu/sites/design.umn.edu/files/2021-09/mary-guzowski-profile-publications-visionary-challenge-2020.pdf Accessed (6 November 2023).

Isenberg, P., Elmqvist, N., Scholtz, J., Cernea., D., Ma, K.L., Hagen, H.:
Collaborative visualization: definition, challenges, and research agenda. J. Inf. Vis. – special issue on state of the field and new research directions 10(4), 310–326, October 2011. Sage Publisher (2011).

Longo, G., Middleton, D. Albano, S, Elaborating a design framework that is able to structure and guide composition of Generative AI visualizations. (Forthcoming) IHIET-AI, AHFE International Proceedings 2024.

Middleton, D A. Seeking Cognitive Convergence: Small Group Collaborative Visualization in the Library Learning Commons 2019 T. Ahram et al. (Eds.): IHIET 2019, AISC 1018, pp. 143–149, Springer Nature. https://doi.org/10.1007/978-3-030-25629-6_23 (2020).

Fig.23 AI Visualization by Congruo Guan - Final visual production - Phase 2

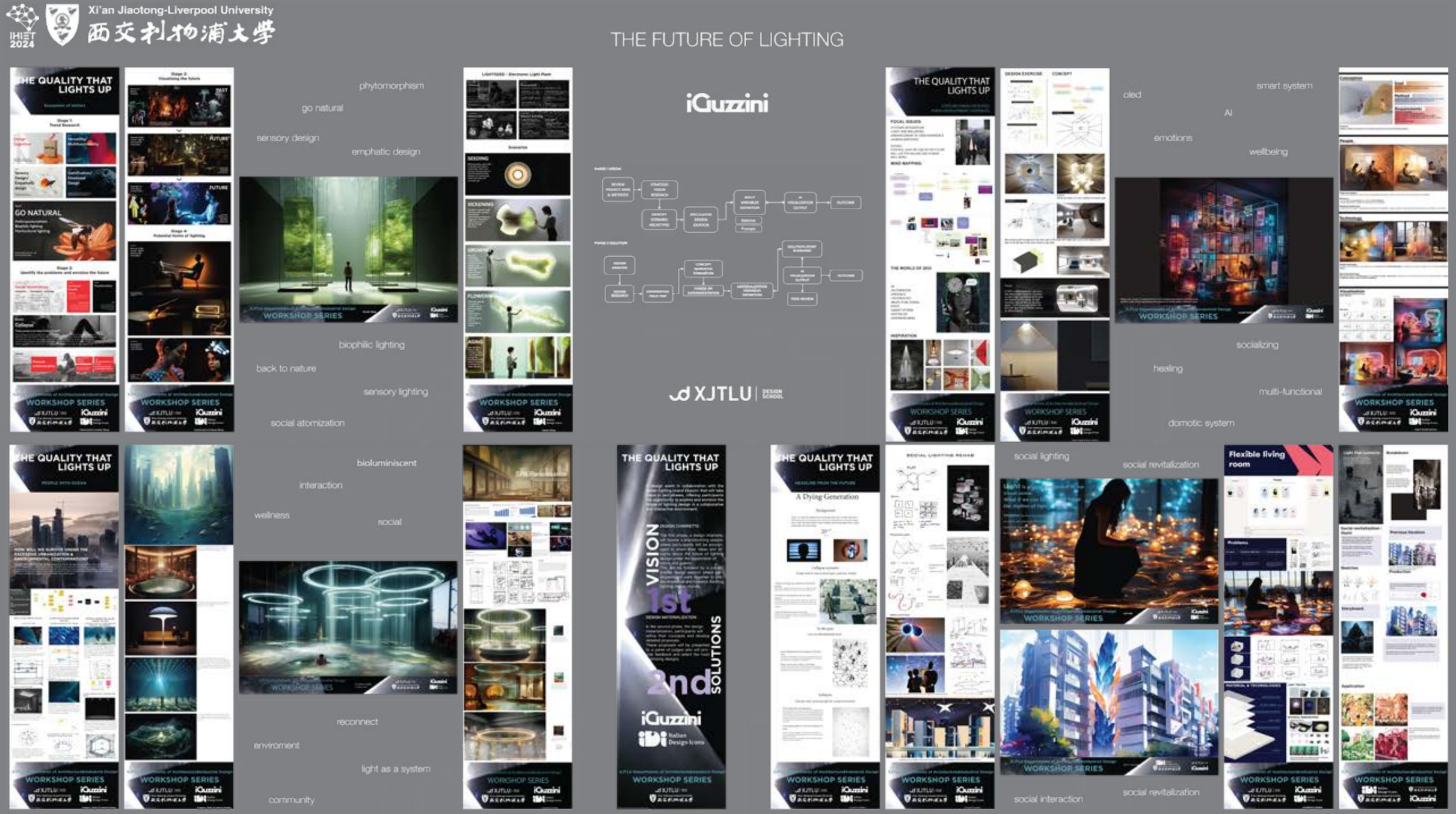


Fig.24 Overview of all final results Phase1 and 2 (exibited in Shanghai at IDI Shanghai - november 2023).

11th International Conference on Human Interaction & Emerging Technologies:
Artificial Intelligence & Future Applications

April 25-27, 2024, Centre Hospitalier Universitaire Vaudois (CHUV), Lausanne, Switzerland

Thank you for your attention!

Silvia Albano[1] Deborah Middleton[2] GianMarco Longo[3]

Xi'an Jiaotong-Liverpool University
西交利物浦大學