Dynamics of Disciplines: Understanding Task-level Experiences in Interdisciplinary Collaborative Design Studio Education

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Successful design solutions that respond to the built environment's complex challenges require unprecedented interdisciplinary expertise. U.S. accreditation standards (NAAB, CIDA, LAAB) for Architecture, Interior Architecture, and Landscape Architecture acknowledge this, promoting student collaboration. The AIA's 2020 report also indicates 39% of firms are multidisciplinary, emphasizing prevalent collaboration across disciplines in practice. This study explores students' experiences with interdisciplinary collaboration and task-level disciplinarity dynamics, aiming to identify challenges and improve course guidance strategies. Two key insights emerge from the data. First, tasks where all disciplines exhibit high comfort, may demand more structure and guidance from faculty, and suggest the incorporation of some independent work within collaborative efforts. Secondly, the effectiveness of teamwork is contingent upon the flexibility and adaptability of team structure and leadership. Recognizing when collaborative efforts are crucial for specific tasks, and identifying when independent work is warranted, is a critical component of this dynamic. This study contributes to the understanding of disciplinary dynamics in design projects at the task level, potentially improving collaborative workflows. The findings can inform guidelines and strategies for other institutions, providing a resource for faculty and programs navigating interdisciplinary design studios.

1. INTRODUCTION

1.1 BACKGROUND

The increasing complexity of needs and challenges that intersect at the scale of the built environment, necessitates a wider range of expertise, making collaboration essential to architectural design. Recognizing this need, current U.S. accreditation standards for programs in Architecture, NAAB, Interior Architecture, CIDA, and Landscape Architecture, LAAB, call for students to have collaborative educational opportunities for students. Both NAAB and LAAB requirements highlight the importance of collaboration through PC.6, Leadership and Collaboration[1] and 2.h, Collaboration[2] criteria respectively. Similarly, CIDA requirements not only mandate that "interior design students collaborate and participate in interdisciplinary design teams" but also that students understand "the dynamics of team collaboration and the distribution and structure of team responsibilities."[3] Moreover, the AIA's annual 2020 firm survey report revealed that 39% of architecture firms identify as multidisciplinary, underscoring the widespread nature of collaboration between disciplines in practice.[4]

The importance of multidisciplinary and interdisciplinary research has grown in recent decades.[5] Despite previous studies examining more effective ways to collaborate within design disciplines[6], the dynamic of disciplinarity at task level within a design project remains largely unexamined, as does the experience of design students collaborating with different disciplines throughout the design process.

1.2 PURPOSE OF STUDY

This study aims to gain deeper insight into students' collaborative experiences and task level disciplinarity dynamics during interdisciplinary collaborations. Understanding this dynamics can identify challenges and devise strategies to enhance guidance during the course, thereby improving the educational experiences and outcomes. This study specifically focuses on addressing the following research questions: 1) How do students perceive collaboration with other design disciplines? 2) What is the task-level dynamic of disciplinarity during studio projects? 3) How do students compare the quality of collaborative and independent outcomes for various tasks? and 4) How does the degree of similarity and difference between disciplines influence the performance of diverse tasks during collaboration?

1.3 INTERDISCIPLINARY COLLABORATIVE DESIGN STUDIO

For three years, Kansas State University's APDesign College has offered a 5-credit, vertically integrated, graduate Interdisciplinary Collaborative Design Studio to Architecture (ARCH), Interior Architecture (IARC), and Landscape Architecture (LARCP) students. Small teams from each discipline collaboratively work on diverse design projects over a 16-week semester.

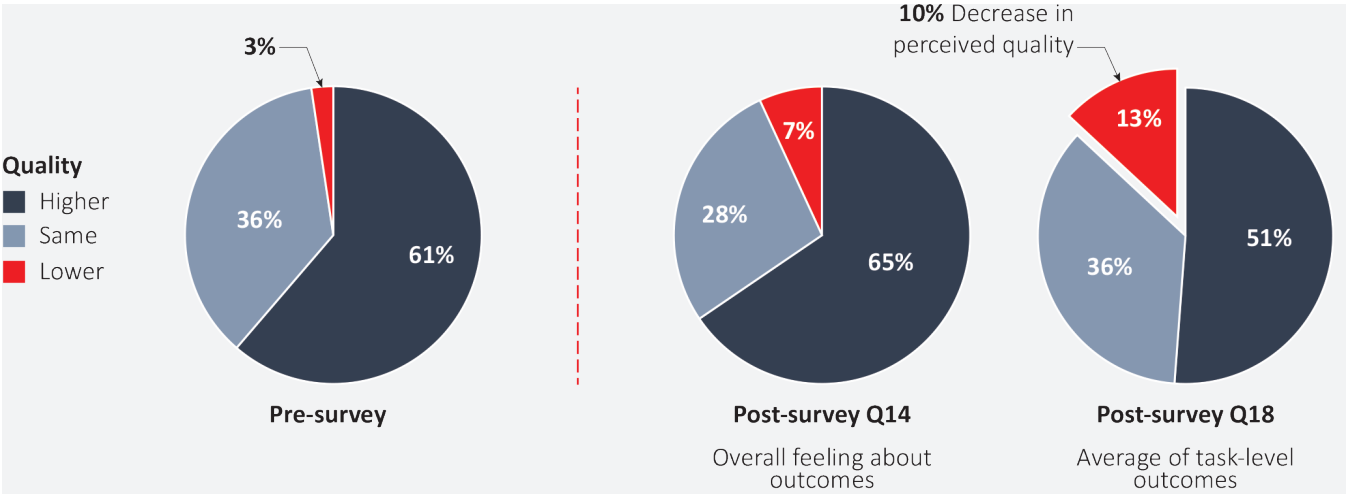

Figure 1. Perceived quality of the collaborative design outcomes relative to independent design work. By Authors.

2. RESEARCH METHODOLOGY

In this study, the authors approached a cohort of 46 interdisciplinary students. A pre-survey was utilized to gauge their expectations. After that, a more detailed post-survey was conducted to capture their experiences collaborating with students from other disciplines as a team.

2.1 PARTICIPANTS

Out of the 46 recruited students, 25 participated in the pre-survey (LARCP=6, ARCH=9, and IARC=10), and just over 60% (28 students, LARCP=12, ARCH=6, and IARC=10) participated in the post-survey. The participants from each discipline were adequately represented, with slightly more representation from LARCP in the post survey.

2.2 TASKS

The authors selected twelve tasks that occurred throughout the semester and design process to gather information on the disciplinary dynamics. Additionally, the tasks are categorized by "type." See the categorized tasks and related activities below.

Design Research

- Urban, context, &/o Site Analysis (SA): thematic mapping, urban analysis
- User, Stakeholder &/o Client Analysis (UA): user/ client interviews, stakeholder mapping, user charrette, user journey mapping
- Programming, activity/ space analysis (PR): precedent studies, activity/ space analysis, project program, adjacency matrix

Development of Design Proposal

- Establish design goals (DG): development of design goals
- Conceptual spatial arrangements/ layouts (CL): bubble and plan diagrams
- Massing & form studies (MS): sketches and models
- Development of design vocabulary (DV): concept boards, details, materials, furniture, and finishes
- Development of interior/ exterior relationships (IE)
- Design Alternatives (DA): idea generation and synthesizing design ideas
- Design Evaluation & Refinement (DR): application and integration of formal and informal feedback

Design Communication

- Visual Communication (VC): design documentation, diagrams, renderings
- Storytelling (ST): verbal presentation

2.3 SURVEY DESIGN

The surveys included Likert-style questions to assess the participant's perceived preparedness, quality of outcomes, level of comfort, importance of collaboration, and approaches to leadership for each task. They also included qualitative short-answer questions to gain a deeper understanding of the students' experiences and provide context for the quantitative results.

2.4 DATA ANALYSIS

The survey results were analyzed and synthesized to generate insightful findings. Thematic analysis involved reading the survey responses, labeling relevant pieces, determining important codes, creating categories, and labeling them.[7, 8, 9] Additionally, a quantitative analysis of survey responses, including Likert scale questions, was conducted to understand data trends and compare participants' response regarding the quality of collaborative outcomes, level of comfort, importance of disciplinary collaboration, and disciplinary leadership at the task level. The results are visualized and presented in the following sections.

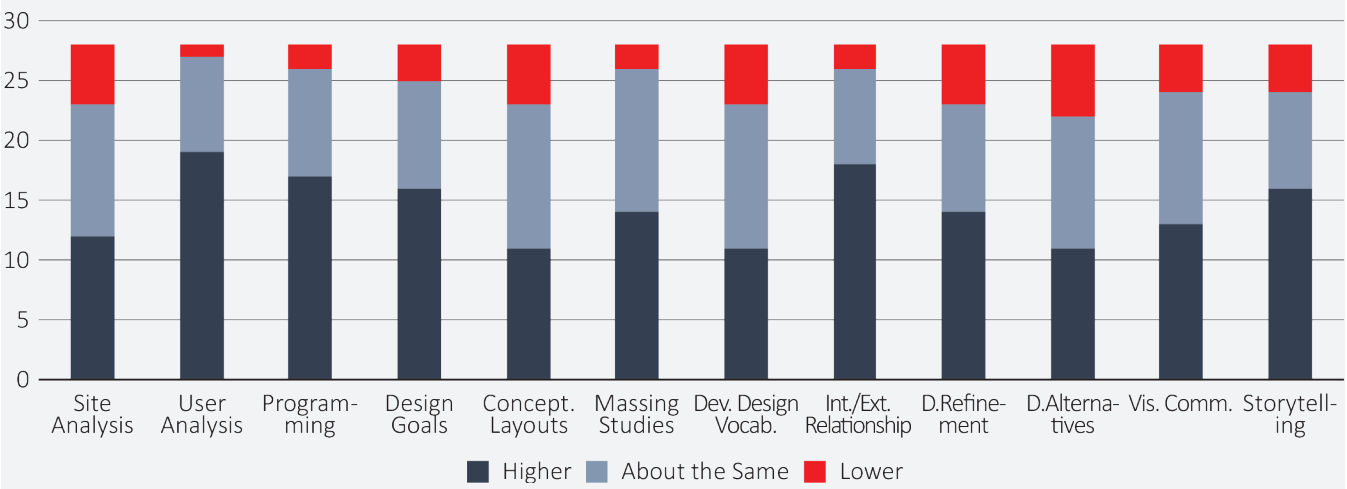

Figure 2. Perceived quality of the collaborative design outcomes relative to independent design work at the task level. By Authors.

3. RESULTS AND FINDINGS

The results and findings from the analyzed and synthesized data are presented in the following categories. Pre-survey results encompassed the participants' the previous experience of collaborating with other design disciplines, their perceived preparedness, and the overall perception of the collaborative outcomes quality compared to the quality of outcomes from their individual work.

Also, selected results from the post survey shed light on the dynamics of disciplinarity at task-level, including the perceived quality of outcomes, level of comfort and importance of collaboration.

3.1 PRE-SURVEY

To assess the participants' prior collaboration experience, they were asked their engagement in collaborative work with other design disciplines. The findings revealed that 60% of the students (n=15) had previous experience in interdisciplinary collaboration. This suggests that a significant portion of the surveyed students possessed prior experience in working collaboratively across design disciplines.

Additionally, participants were asked to evaluate their feeling of preparedness for the collaboration during the studio, with response options ranging from "very prepared" to "not prepared." The results showed that 64% of the students considered themselves prepared, with 12% feeling very prepared and 52% feeling adequately prepared. 24% of students indicated feeling somewhat prepared, while only 12% reported feeling less prepared.

The combination of a majority of students reporting previous collaboration experience and feeling prepared for the collaborative work, potentially due to some familiarity with working in teams within college in their previous lecture courses. This familiarity may contribute to their ability to navigate the challenges and dynamics that arise in collaborative settings.

3.2 QUALITY OF OUTCOMES

This study sought to understand how participants perceived the quality of collaborative and independent outcomes for various tasks. Participants were asked to rate the perceived quality of collaborative design outcomes relative to independent design work using a Likert scale in both the pre and post surveys, indicating whether they perceived the outcomes to be higher, about the same, or lower.

In the pre-survey, the majority of participants (61%) believed that the collaborative outcomes would be better, while only 3% thought they would be worse (see Figure 1, left). In the post-survey, 65% of participants responded that the overall collaborative outcomes were better, but 7% felt that some outcomes were worse (see Figure 1, middle). However, task-level responses in the post-survey, which involved averaging the participants' responses per task, showed a 10% decrease in perception of collaborative outcomes compared to the pre-survey results (see Figure 1, right).

Although the overall perception of the quality of outcomes from pre- and post-survey responses were generally positive, the authors aimed to understand the factors contributing to the increased perception of worse outcomes shown at the average of task-level outcomes. By comparing participants' expectations and their actual experiences through task-level data, tensions between the myths and the realities of interdisciplinary collaboration were exposed.

Further analysis identified a few tasks contributed most significantly to the 10% drop in perceived outcome quality. These tasks included site analysis, spatial layout (specifically conceptual layouts), design vocabulary development (specifically the creation of a shared design vocabulary), design refinement (including iterating and evaluating design alternatives), and design development (refining and developing the design proposal).

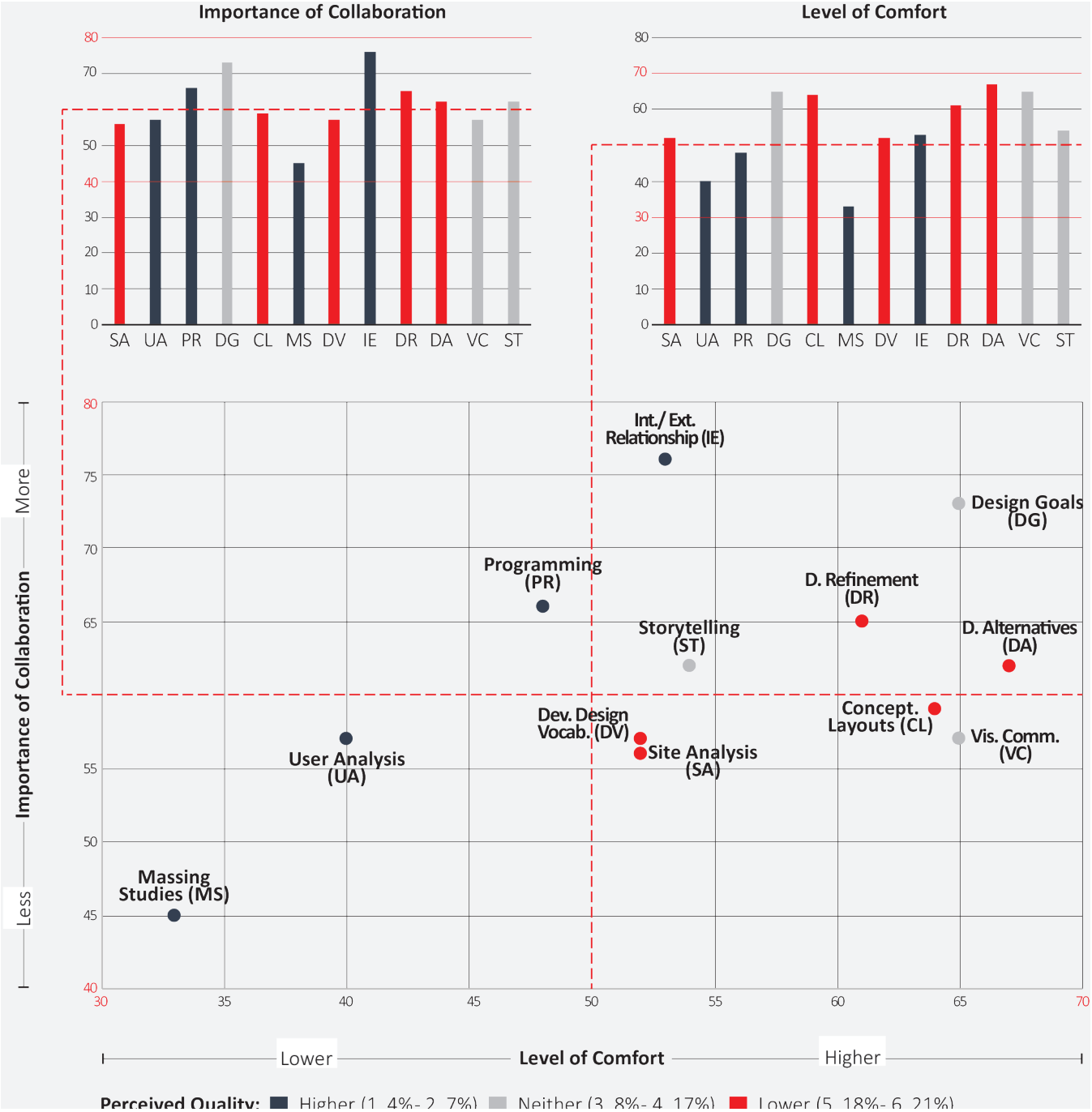

Figure 3: Mapping the relationship of comfort, collaboration, and perceived outcome quality. (n, % respondents perceiving lower collaborative outcome quality). By Authors.

Participants reported the perceived the quality of collaborative outcomes as worse compared to working alone in these areas.

The majority of respondents felt the perceived quality of collaborative outcomes of the User Analysis were at least equal to, if not better than, individual work (see Figure 2). Over 68% of students believed the results achieved through interdisciplinary work surpassed what they could accomplish alone, with only one respondent expressing a contrary opinion. Conversely, tasks involving the iteration and evaluation of Design Alternatives yielded the highest number of respondents who perceived the collaborative outcome as inferior to what they might have achieved individually. These findings highlight that the variability in the effectiveness of student collaboration in relation to perceived outcome quality is task dependent.

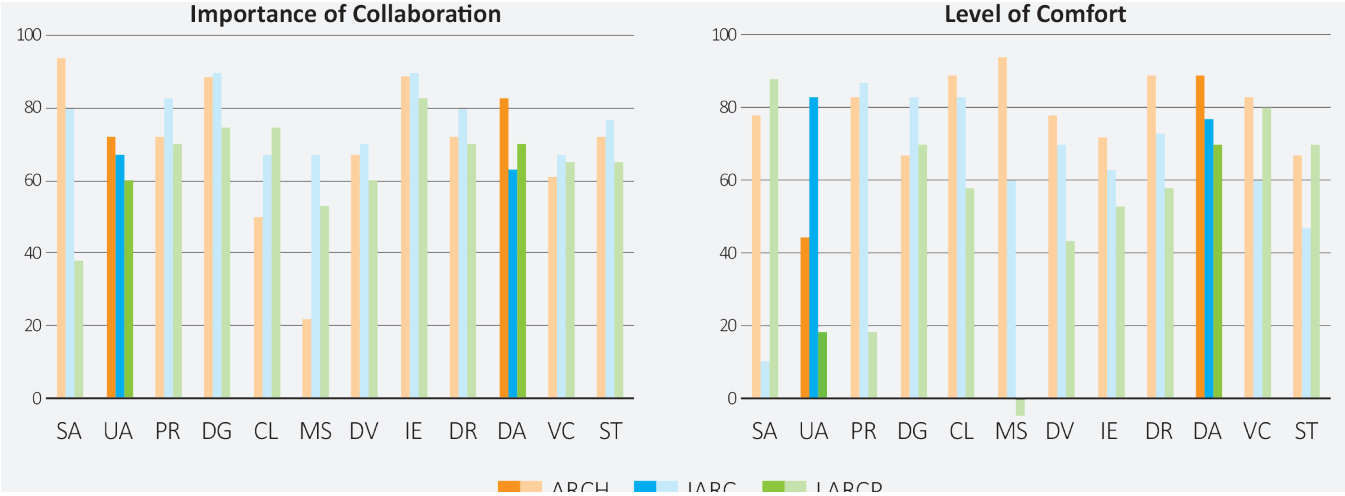

Figure 4. . Disciplinary comfort and importance of collaboration (Note: as the number of participants are different for each discipline, the numbers are scaled to 100 for comparison). By Authors.

3.3 IMPORTANCE OF COLLABORATION AND LEVEL OF COMFORT

To gain further insights into the factors influencing collaboration effectiveness, participants were asked about both their level of comfort and the importance of interdisciplinary collaboration for each task in the design process. The data gathered about participants' comfort levels provided insights into their self-perceived strengths and weaknesses across various tasks. Furthermore, it elucidated the value and importance individuals attached to interdisciplinary collaboration.

Participants were asked to rate their level of comfort and the importance of disciplinary collaboration for each task by selecting from a 5-point Likert scale (Very high, High, Neither High nor Low, Low, or Very Low). To enable effective data comparison, the Likert scale responses were quantified as follows: numerical values were assigned to each option (Very high=3, High=2, Neither High nor Low=1, Low=-2, Very Low=-3), and the number of responses for each option was multiplied by its corresponding value. The resulting values were then summed to determine a total score.

For instance, the User Analysis task had the following responses:

- Very high: 10 responses,
- High: 9 responses,
- Neither High nor Low: 4 responses,
- Low: 3 responses, and
- Very Low: 2 responses.

To calculate the score, the number of responses for each option was multiplied by its assigned value and the results were summed: (10 x 3) + (9 x 2) + (4 x 1) + (3 x -2) + (2 x -3) = 40. Hence, the total score for the students' responses in the user analysis task is 40.

The quantified data for each task is visually presented in Figure 3 for better understanding and analysis.

To enhance the efficiency of the diagrams and extract the most relevant and informative features, redundant variables were removed from the data. The perceived quality of outcomes was mapped onto a quadrant chart that compared level of comfort against importance of collaboration, synthesizing the data into a comprehensive visualization. This approach aimed to improve the efficiency of the diagrams and highlight the key aspects of the data (see Figure 3).

The consolidated chart highlights unique patterns in the data. Overall, collaboration was deemed at least moderately important for most tasks (60). While collaboration was considered less critical with Massing Studies, the perceived quality of outcomes from collaboration was generally regarded as superior compared to individual work. The data also indicates a significant positive relationship between the level of comfort and the importance of collaboration for "higher quality outcomes" up to a moderate level of comfort (50). However, as comfort exceeds this threshold, the perception of collaborative outcome quality diminishes. Only one task, Interior/ Exterior Relationships, had less than 7% of respondents perceived lower outcome collaborative outcome quality compared to individual works, fell within the quadrants corresponding to higher comfort levels.

These findings highlight the possibility of a stronger relationship between the perceived outcome quality and the level of comfort with a task than the perceived quality of outcomes and the importance of collaboration. These also implies that the collaborative approaches must vary according to the characteristics of each task in order to generate positive collaborative outcomes. Two tasks, User Analysis and Design Alternatives, requiring different work methods, serve as excellent examples to illustrate the significance of comfort alongside the dynamics of task-level

disciplinarity. User Analysis, primarily analytic and front-loaded in the course structure, contrasts with Design Alternatives, an iterative task continuing throughout the semester.

Analysis by discipline indicated a general consensus on the importance of collaboration. However, when considering participants' comfort levels with each task, a disparity is revealed (see Figure 4). For instance, IARC students were quite comfortable with User Analysis, ARCH students moderately so, while LARCP students expressed relatively less comfort. Examining tasks involving Design Alternatives, all three disciplines had a high level of comfort, but this task had the most responses indicating a less favorable perception of collaborative outcomes compared to individual work (see Figure 3). This pattern recurs in most cases when considering overall perceptions of outcomes for tasks in which two or more disciplines exhibit higher levels of comfort (see Figure 4). These findings indicate tasks in which all disciplines exhibit high comfort, may demand more structure and guidance from faculty, and suggest the incorporation of some independent work within collaborative efforts.

3.4 DISCIPLINARY LEADERSHIP AT THE TASK LEVEL

Participants were asked to choose their preferred group organization style: horizontal (collaborative decision-making with intense communication), vertical (coordination through a hierarchical structure with a student team leader), or a mix of both.[10] The results showed that most participants (89%) opted for a mix or horizontal approach (46%, n=13 and 43%, n=12 respectively), while only 11% (n=3) with a vertical style (see Figure 5).

The results imply that participants value collaboration and open communication in group decision-making in most of the tasks. They tend to avoid strict hierarchical structures and appreciate flexible approaches that adapt to the specific needs of different tasks. However, the data also indicates that participants did not uniformly adopt a strictly horizontal group organization. Instead, they seemed to adapt the vertical dynamic for certain tasks, likely with the aim of improving efficiency and productivity. This indicates an understanding of the characteristics of different tasks will help the team members to employ flexible strategies to achieve optimal outcomes.

3.5 QUALITATIVE RESULTS

To gain insights into the factors driving students' perceptions, participants were asked to describe strengths and areas for improvement in the collaborative experience. Additionally, they were prompted to share their experiences with disciplinary techniques, values, and languages. The collected qualitative data was analyzed and synthesized to identify emerging themes.

Strengths and Similarities

Effective Communication: Participants highlighted the importance of active listening, respectful communication across disciplines, and regular check-ins. They also mentioned the ability to divide work and leverage each team member's strengths.

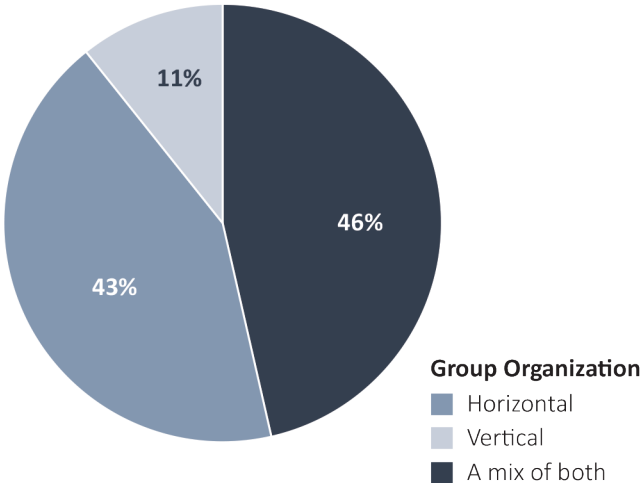

Figure 5. The dynamic of group organizational structure. By Authors.

Differences in Approaches as an Asset: The diverse approaches to spatial relations and design decisions were viewed positively, offering valuable insights and alternative perspectives that enriched the overall design process.

Learning and Growth: Collaborative experiences fostered learning opportunities, allowing participants to teach one another and expand their understanding of different disciplines. The expertise from other fields was highly valued, enabling informed decision-making and a willingness to contribute beyond one's area of expertise.

Leadership and Collaboration: Participants emphasized the significance of effective leadership, with a designated team member acting as a cohesive force. They also valued collaborative decision-making processes.

Similarities in Design Processes: Commonalities in the design process were regarded as beneficial for them as it contributed to smooth collaboration across different tasks and disciplines.

Support and Patience: Team members' support and patience fostered a safe and conducive environment for collaboration, enabling free expression of ideas and promoting mutual learning without fear of judgment or criticism.

Differences and Challenges

Poor Communication: Participants noted issues such as inadequate communication between team members, lack of feedback on specific disciplines, confusion due to ineffective communication, discrepancies in technology usage, and differences in disciplinary vocabulary.

Ineffective Leadership and Decision-Making: Challenges arose when workload distribution and understanding of team members' abilities were not properly balanced, leading to potential inefficiencies and conflicts within the team.

Differences in Approaches as a Barrier: Conflicting production expectations, divergent approaches, and varying priorities among disciplines posed challenges to effective collaboration. Some participants suggested the need for a leader or a formalized decision-making process to enhance productivity and project direction.

Scheduling, Time Management, and Pacing Differences: Conflicts in scheduling, varying work habits, and different work rates resulted in design process delays and difficulties in collaborating outside of class time.

The findings from students' perspectives indicate the need for a nuanced approach to collaboration at the task level. It is evident that a one-size-fits-all approach is insufficient. For instance, diverse approaches were viewed as strengths, fostering alternative design perspectives and knowledge exchange. However, conflicting approaches, varying priorities, and differences in production expectations posed challenges. Understanding each other's abilities was also highlighted as essential for successful collaboration.

4. DISCUSSION

4.1 SIGNIFICANCE OF UNDERSTANDING TASK-LEVEL COMFORT

The study's findings indicate that a student's comfort level with a specific task plays a significant role the dynamics of interdisciplinary collaborations. As discussed previously, tasks in which the level of comfort tended to be equal or high among the majority of teammates, the collaborative outcomes were more likely to be perceived to be lower in quality than individual work. Identifying a student's comfort level with a task offers valuable insights for guiding collaborative work effectively. The creation of assessment tools to gauge comfort at the task level, could provide insights that would enable faculty to potentially pinpoint tasks that require alternate collaboration strategies. Looking at the thematic analysis alongside the quantitative findings, sheds light on several influencing factors while suggesting potential methods to enhance collaborative experiences. Communication, both good and bad, was a pivotal theme that emerged from the thematic analysis. Successful collaborations stem from effective communication. When all team members share equal and high levels of comfort with a task, the study suggests that there is increased need for tools that can aid students in maintaining open channels for dialogue, dropping disciplinary jargon, developing shared goals, and communicating expectations.[11, 12]

Another benefit of understanding student of comfort at the task-level, lies in the act of self-assessment. A study of interdisciplinary collaborations among engineering students identifies both reflective behavior and recognizing disciplinary perspectives as two of three key measures of evaluating interdisciplinary collaborations; the third is interdisciplinary competence (Lattuca, et al. 2012, 25.415.8).[13] Asking students to evaluate their comfort levels not only offers insights for faculty to effectively guide them in different tasks but also fosters a reflective design practice among students, simultaneously enhancing their comprehension of their own disciplinary approaches, expertise, and limitations. Participants frequently compared their own disciplinary perspectives and proficiency with insights on the breadth and expertise of other disciplines, suggesting that integrating team-building activities and individual or group reflections, could enhance students' comprehension of their own discipline, fostering an appreciation for others. Thus, these tools could promote the cultivation of soft skills integral to successful collaboration.

The assessment reveals unequal levels of comfort among team members for a task, presenting opportunities for peer teaching. When discussing the strengths of the interdisciplinary collaboration, participants often cited opportunities learning and growth as a strength of the collaborative experience. One participant noted, "the team members each brought their own knowledge, we were able to teach one another new things." Other participants cited, "…learning from each other" and "…willingness to learn" as strengths of their collaborative approach. Varying levels of comfort among students when approaching different tasks also present an opening for discussions with faculty or consultants in their respective fields highlighting how interdisciplinary skills translate to individual disciplines. Additionally, preparation materials can introduce disciplinary concepts and demonstrate how they are adapted and applied in other disciplines acting as a platform for the students to find common ground.

Disciplinary differences, while contributing to the strength of collaborations, can also present challenges. An enhanced understanding of task-level comfort can bolster effective communication, foster positive attitudes, promote respect, and facilitate effective decision-making. Such insights could be instrumental in mitigating potential difficulties encountered within interdisciplinary teams.

4.2 MYTH VS. REALITY OF COLLABORATION

A prevailing assumption among students suggests that continual collaboration invariably yields superior results compared to solitary efforts. Nonetheless, the study reveals that this is not consistently the case, underscoring the necessity for flexibility and fluidity in a team's internal structure and leadership. While many participants mentioned collaborative decision-making as a strength, approaches that divided the work among team members were also frequently mentioned as effective. As one participant mentioned, "talking through big ideas together and periodic check-ins [to keep them] on the same page…". Another mentioned that their group, "worked independently on certain

areas that related to [their] skills and then came together…". Discerning when collective action is integral for specific tasks, while simultaneously assisting students in identifying when independent work might be warranted, is essential. Insights into task-level dynamics of disciplines can assist in crafting task-level leadership and collaboration strategies to foster effective collaborations within the design studio environments.

4.3 LIMITATIONS & NEXT STEPS

There are several objectives when considering future research directions. First, the development of tools specifically designed to facilitate task-level collaboration through an assessment of task-level comfort is crucial. These tools should not simply be implemented, but their effectiveness can also be evaluated to ensure they are contributing to the improvement of the collaborative process.

Second, the disciplinary distribution of the participants may be a possible limitation of the current study findings. The scope of the study is set to be broadened to incorporate data from the upcoming academic year. By enriching the data set, a more comprehensive understanding of the dynamics involved in interdisciplinary collaborations can be cultivated. Furthermore, the inclusion of new targeted questions based on this initial study is planned to unpack the intricacies of comfort and collaboration in greater detail.

These future endeavors underscore the research's commitment to enhancing the understanding and improvement of collaborative experiences within interdisciplinary design studio environments.

5. CONCLUSION

In conclusion, the current NAAB, LAAB, and CIDA accreditation requirements emphasize the importance of collaboration and interdisciplinary design teamwork. The results and findings of this study provide valuable insights into the dynamics of interdisciplinary collaboration among students in Interior Architecture, Architecture, and Landscape Architecture. By addressing four crucial research questions, the findings underscore the significance of tailoring collaboration strategies to the task level. Students' perceptions of collaboration and the quality of outcomes were shown to be task-dependent, emphasizing the need for nuanced approaches. The study also highlighted the importance of considering students' comfort levels, which can serve as an indicator of perceived outcome quality. Additionally, disciplinary differences were found to be both a strength and a challenge in collaborative settings, with effective communication, positive attitudes, and strong leadership identified as essential factors in mitigating challenges. The implications of this study can extend to design education programs, informing faculty and institutions seeking to optimize interdisciplinary design studio experiences. By leveraging the insights gained from this study, educators can foster more effective collaboration, ultimately leading to more innovative and comprehensive design outcomes.

ENDNOTES

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