CITC GLOBAL
Construction in the 21st Century

The Thirteenth International Conference on Construction in the 21st Century (CITC-13)

Arnhem, The Netherlands| May 8 – 11, 2023

Investigating Effectiveness of Construction Education in Collaborative Environments: Learning Within Discipline vs. Across Disciplines

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Abstract

Construction education has shifted to a more interdisciplinary pathway in the recent decades particularly due to constantly evolving environment in Architecture, Engineering, construction (AEC). It is essential for educators to understand this fundamental change and take actions to integrate skillsets that prepare students for such complex work environments. Effective communication and collaboration as important skillsets among disciplines is critical to success. As such, providing a learning environment to simulate teamwork could be significantly resourceful for students. In this study, we collected data from two groups of students in building construction science (BCS) and architecture (ARC) programs at Mississippi State University (MSU) who worked together to complete project(s). We particularly focused on aspects of learning that was influenced by peer-learning and compared the students' perceptions of learning within the same discipline and across disciplines. We also asked if students learned more from professors within their discipline or across disciplines as well as their preference for asking questions from professors within and across disciplines. Additionally, we asked about usefulness and perception of success with respect to peers from the same disciplines and across disciplines. Results indicated high levels of learning in ARC students from their BCS collaborators which can be justified since BCS students are better equipped, in that year level, with software and fabrication skills. Findings of this study are consistent with prior research indicating collaborative environments are helpful in promoting learning. The findings also support the notion that cross discipline collaboration can be at times more productive than same discipline.

Keywords

Construction, Education, Collaboration, Architecture, Effectiveness

1. Introduction

In the recent years, the significance of teamwork and collaboration has become more apparent to industry professionals given the interdisciplinary nature of AEC (Soetanto et al., 2012). As such, there is a shift required in academia to better equip students with tools and technics necessary for thriving in the industry when they graduate. Several studies looked at the feasibility of an educational framework that simulate a similar collaborative environment for students to learn how to work together on group projects (Becerik-Gerber et al., 2011; Oraee et al., 2019, 2021; Rokooei et al., 2022; Rokooei & Garshasby, n.d.). Many researchers within the AEC have focused on findings ways to better understand the student perception of collaboration and teamwork as well as enhancing the learning environment (Bozoglu, 2016; Rokooei & Garshasby, n.d.). Therefore, it is critical to investigate all dimensions of collaboration from the students' perspective so we can better implement features of teamwork that is conducive to student learning.

Collaboration by definition would happen when a group of independent stakeholders participate in an interactive process to solve a problem relying on shared norms and structures (Wood & Gray, 1991). A critical component of collaboration is negotiation between parties with mutual benefits. That being said, not all forms of collaboration is defined similarly due to different nature of the discipline that collaboration is taking place in (Bedwell et al., 2012; Thomson et al., 2009). Nonetheless, the principles of collaboration whether it is happening in the construction industry, or an educational setting remains similar and therefore, the skillsets required to participate in teamwork and collaboration remains similar as well.

Collaborative leaning environments also provide an opportunity for implementing problem-based learning (PBL). PBL focuses on student activities with the notion that students learn better when they experience and participate in learning first hand as opposed to a lecture based mode where there is a speaker and an audience (Soetanto et al., 2012). In MSU, two of the eight core classes are taught collaboratively between ARC and BCS programs via PBL mode. Students work alongside each other in completing a series of projects including a real size bench project through design-build to deliver to the client in the first collaborative studio. Students also work together on designing and developing a proposal for a commercial size building throughout the second collaborative studio. In this paper, we looked at the perception of teamwork and its impact on success and satisfaction levels in collaborative learning environments. The goal was to evaluate the effectiveness of these collaborative environments as well as the perception of students who are participating in these environments.

2. Methods

This paper relies on utilizing a survey questionnaire that was distributed to students in the BCS and ARC programs in Mississippi State University. IRB approval was received, and preliminary information was provided for the participants of the survey. 125 responses were collected (ARC: 34 and BCS:91). Both programs adopt a studio-based curriculum which allows for implementation of group projects and collaboration within and across disciplines. The survey entailed several sections aiming at collecting information on perception of students on learning. In this paper, we focused on aspects of the learning experience that was significantly impacted by collaborations.

We asked students about the degree to which they learned from their team members in their discipline as opposed to their collaborator major. We also asked the students about the degree they learned from their professors in their major as opposed to the professors in the collaborator major. Additionally, we asked the students about their preference in asking questions from their major professors versus the collaborator major. Moreover, we asked students to rate the quality of communication (timeliness, clear, polite, etc.) with their own major teammates versus their collaborator majors. Furthermore, we asked students to rate the usefulness and the degree to which they find the collaborative studio beneficial.

We asked students to vote on the importance of their team members (both own major and collaborate major) on the success of their projects/assignments. In addition, we asked them to rate the impact of several factors including regular feedback professors and teammates, complementary skills, diversity and so forth on the success of collaborative studio. Moreover, we asked them to vote their satisfaction with the performance of their team members (own major vs collaborator major). Finally, we asked the students to what degree they are willing to have another

collaborative studio with their major collaborator versus any other major but their current collaborator. After the completion of data collection, all data entries were cleaned and checked for accuracy. A statistical model was developed to look at components of the inquiry and various statistical analyses were executed via SPSS.

3. Results

The data gathered from participants were analyzed on a "same or collaborator major" basis in this paper. Such categorization helped to clarify the perception of students toward different aspects of a collaborative environment. After the demographic part, the first section of questions explored perception of students about their peers. Participants were asked to rate the extent to which they learned from their peers while peers were from their own major or the collaborative major. Figures 1 shows the percentage of each level rated by both majors, using a Likert scale. As shown, 50% of architecture reported a high or very high level (29% and 21%) of learning from architecture students in their collaborative environment, while this number for BCS students was 53% (46% and 7%).

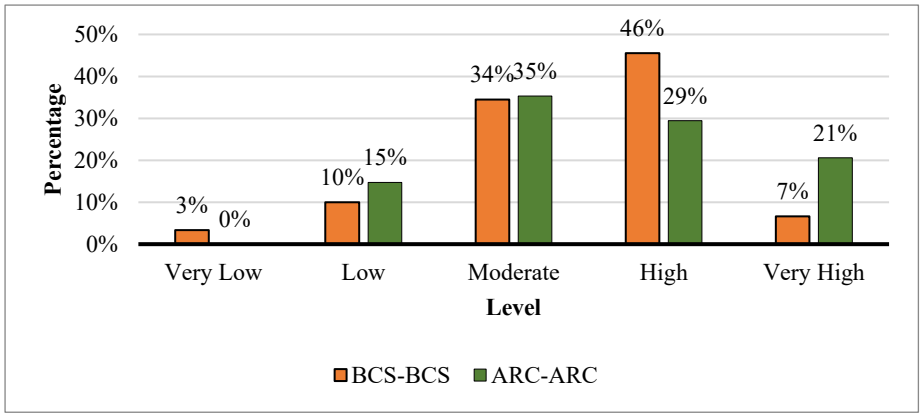

Figure 1: Learning from own major teammates in the collaborative studio

Similarly, participants rated their learning from their collaborative major peers. The percentage of each level is shown in Table 2. As shown in the table, 76% of architecture rated their learning from BCS students as high or very high (55% + 21%) while 17% BCS students expressed a similar opinion about their learning from architecture students (13% + 4%).

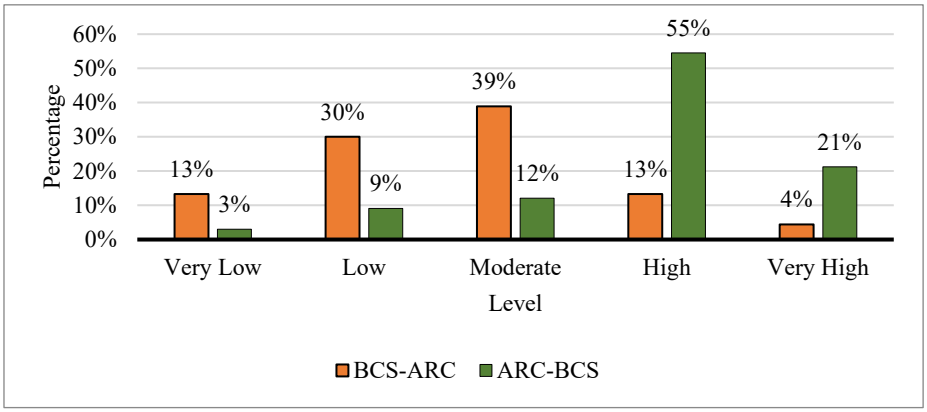

Figure 2: Learning from collaborator major teammates in the collaborative studio

In the next question, students were asked to rate their willingness to ask the questions or discuss the points with own major instructors in the collaborative environment. Figures 3 and 4 show the percentage of each Likert

level for students' willingness to interact with their own major instructors (Figure 3) and their collaborative major instructors (Figure 4).

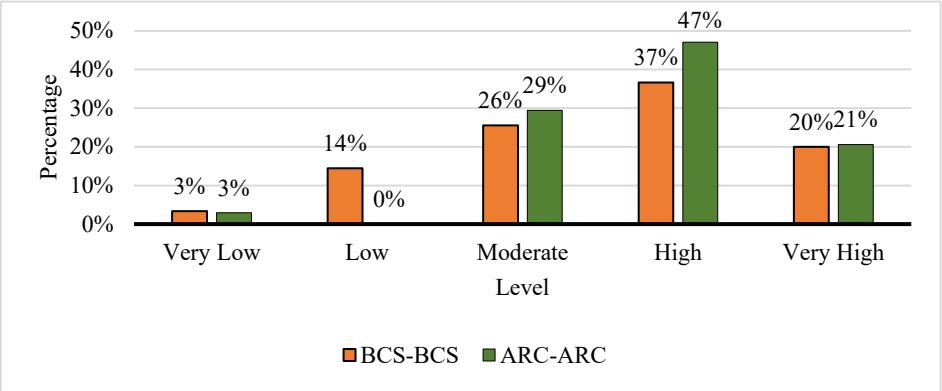

Figure 3: Willingness to interact with own major instructors

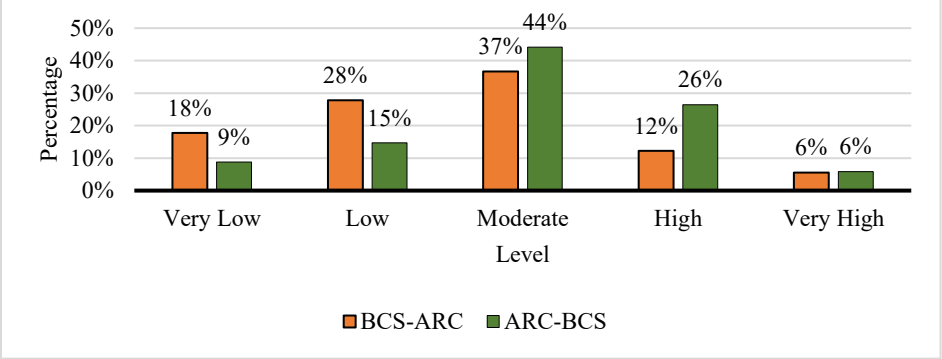

Figure 4: Willingness to interact with collaborative major instructors

In the next section, students evaluated the quality of their communication with their own or collaborative major students. Both majors highlighted the high quality of the communication with their own major peers (architecture: 35% as high and 26% as very high vs BCS:42% as high and 16% as very high). A similar situation was reported as the quality of communication in working with collaborative major teammates (architecture: 15% as high and 15% as very high vs BCS:33% as high and 4% as very high).

In the next section, students rated the extent to which they believed the collaborative environment would have been useful if they had it with their own major students (Figure 5) or with their collaborative major students (Figure 6). In other words, students were asked to rate the usefulness of educational environment in single major or double major structure. A five-level Likert scale was used to quantify the evaluations.

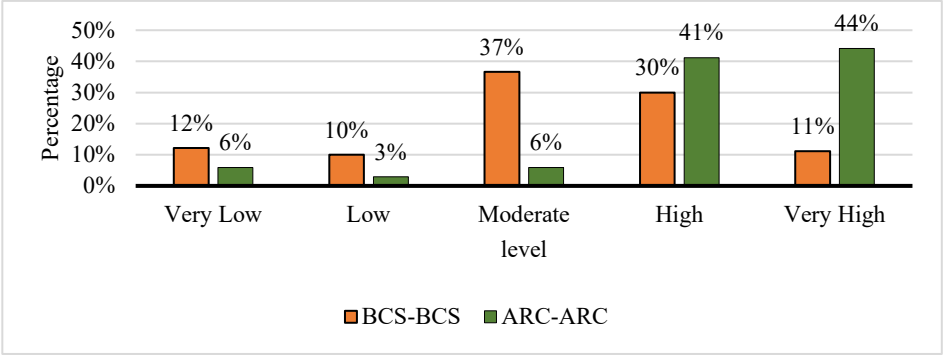

Figure 5: Usefulness of collaborative studio with own major teammates

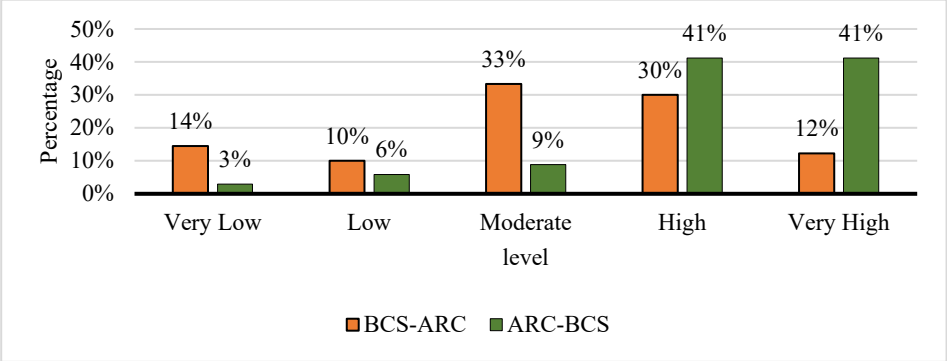

Figure 6: Usefulness of collaborative studio with collaborative major teammates

Also, students were asked to rate the impact of a series of pre-defined factors on the success of collaborative educational environments. Factors included regular feedback by professors, teammates, colocation, diversity, effective communication, trusting relationships, mutual benefits, commitment to participate, and shared understanding. A five-level Likert scale was used to quantify the perceived impact. The average score of each factor (out of 5), categorized by major, is shown in Figure 7.

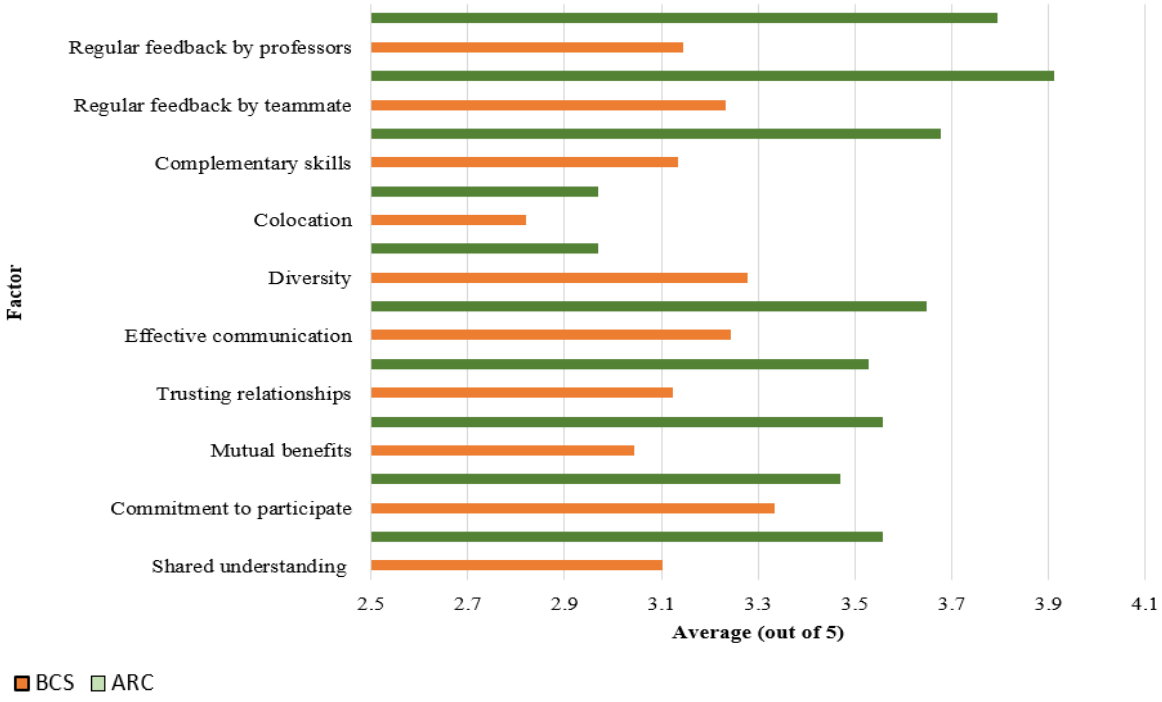

Figure 7: Impact of factors on the success of the collaborative educational environment

4. Discussion

The perception of students about different aspects of their educational environment plays a major role in their learning process. Such perceptions become highlighted when students participate in a collaborative environment in which they attend classes which are not necessarily housed in their department, interact with students from other majors, learn from instructors whose major, emphasis, and approaches may be different. The current study explored the perception of construction and architecture students in collaborative environment with a heavy load of project-

based learning activities. The educational structure of the courses required students to constantly interact with each other, rely on their peers' work to continue, and be responsible for the entire team output.

This paper shows a portion of data through the lens of major. Both groups showed similar perceptions about a number of items, however, different viewpoints in some other areas were notable as well. Architecture students reported a higher level of learning from their BCS peers, as shown in Figure 2. They also expressed a higher level of willingness for interacting with the other side (Figure 4). Another notable point is the factors impacting the success of collaborative environment rated by BCS and architecture. In all areas, except diversity, the average score was higher in the architecture group. It is noteworthy that female students comprise about 50% of students in architecture, while this number in BCS is 8%.

5. Conclusion

This paper aimed at investigating the effectiveness of collaborative learning environments with a particular attention to cross-disciplinary versus single disciplinary paradigms in two collaborative studios between ARC and BCS programs at Mississippi State University. The findings supported the idea that students perceive learning more effective when they engage in collaborative projects. There were areas in which, students from each major shared slightly different votes but the overall analyses supported the effectiveness of cross-disciplinary learning environments.

It is important to note that students who participated in this study had different levels of training and backgrounds that may have impacted their level of preparedness to collaborate and therefore influence their perception of effectiveness of collaboration and collaborative studio in general. Additionally, in our study, BCS students were better equipped with technical skills in modeling and fabrication which was essential to completion of projects. This may shed light on nuances in responses to questions regarding learning from collaborative major in ARC students since the BCS students are better equipped to complete the projects.

As educators, we will need to constantly look for ways to prepare students for future workforce development. The results of this study along with the existing literature supports the notion that simulating teamwork and collaboration in educational setting can provide an effective platform for addressing learning objectives in construction education. Moreover, findings of this study support the idea that cross-discipline collaboration has been more effective and productive than single-discipline collaboration. More investigation is needed to better understand how collaboration in construction education may yield similar results under different circumstances. Finally, understanding the students' perceptions is integral to implementing efficient mediums in delivering optimal construction educational content.

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