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Crossing the Finish Line Together: Collaborative Team Learning in Design Studios

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Abstract: Shaped by technological advancements and external forces, the narratives of contemporary architecture practices shift from the celebration of the master architect to the collaborative team player in explorative enterprises. Curiously, our studio culture remains lukewarm to such disruptions. The studio pedagogical framework embedded in our design studios of how design tutors teach plays a quintessential role in shaping future architecture educational discourses. It is argued that the traditional one-on-one desk crits have limited potential for breeding new modes of cross-industry design practices. To date, the relevancies of such ubiquitous hierarchical master and apprentice teaching pedagogical structure remains unchallenged. This paper argues for a collaborative design studio characterised by collective actions and mutual support as an alternative. This research examines the repercussions of an experimental model of facilitating architecture design studios with a reinforced focus on collaboration (Collaborative Team Learning - CTL) comparing against the traditional one-on-one (OOO) studio pedagogy. CTL’s pedagogical strategy situates the design tutor as an enabler, engaging students in a cross-pollinative and collaborative approach. At the end of the academic year, students were invited to complete a paper-based questionnaire to gauge their learning experience. Preliminary analysis revealed that CTL students accomplished improved academic performance, instillment of self-directed peer-to-peer learning and lower attrition compare with OOO students. This research advocates that these CTL experiences play a pivotal role in inculcating collaborative mindsets for emerging modes of architectural practices that centre on effective communications, emotional intelligence and negotiations.

Keywords: design studio pedagogy; learning experience; collaboration; heterarchy; cross-pollination

1 Introduction

Over the past decades, we have witnessed notable progressions in architecture and design alongside improvements in construction technologies, computational tools and advanced fabrication techniques. These advancements rewrite the narratives of having the architect as the Master Designer to the collaborative team player in contemporary practices. Curiously, architecture education’s studio pedagogy remains lukewarm to such disruptions and the stratified one-on-one studio pedagogical framework of Tutors as Masters and Students as Apprentices remains unchallenged. Throughout this paper, the term studio pedagogical framework refers to the method of facilitating student’s design work in progress with formative intents. Researchers have argued that we can understand how students learn and the
implications for their academic achievements by focusing on their learning environment (Prayoonwong & Nimnuan, 2010). The discourse of our studio learning environment must not be limited to the confines of our physical teaching space, but rather, the pedagogical frameworks and learning culture embedded in our design studios.

Practice and academia can never be divorced. Institutions often look to practice’s changing dynamics and advancements to steer their academic directions. In the 21st century context of accelerated change, academia can no longer rely entirely upon the state and cultures of contemporary practices to chart its prospects. In recent years, various architectural studio typologies, e.g., research studios, participatory design and interdisciplinary studios (within built environment disciplines) are conceived to respond to the changing landscapes of practice (and vice versa). Despite this, the pedagogical environment in academia resides comfortably in a dismal state of stagnation (Salama, 2016). While design professionals pride themselves as agents of change advancing their respective fields, it is perplexing as to why we have remained conservative in our design for an appropriate studio pedagogy reiterating the one-on-one studio teaching practices inherited from the 20th century. This paper highlights the challenges of such one-on-one individualised desk crits in instilling collaborative mindsets as breeding conditions for alternative modes of cross-industry practices to emerge. To date, pedagogical experiments that deviate from the individualistic one-on-one desk crit pedagogical framework of studio facilitation is sporadically examined (Goldschmidt, Casakin, Avidan & Ronen, 2014). Thus, this research evaluates students’ learning experience and its repercussions of both authoritative one-on-one (OOO) desk crits and the experimental Collaborative Team Learning (CTL) pedagogical framework during formative design reviews. This paper hypothesises that students immersing in CTL would achieve improved academic performance, learning experiences, efficiencies in their self-directed peer-to-peer learning and student retention.

In this experimental CTL, tutors lead design reviews in a small-sized student team facilitating in a non-hierarchical and collaborative approach within the freshmen’s architecture studio throughout one academic year. Can design educators lecture effectively in teaching collaborative mindsets for emerging modes of practices? Unlikely. Conversely, tutors can inculcate such mindsets in their daily engagements with students. The tutor is both an actor and an enabler. It is argued that students will foster valuable soft skills like critical thinking and complex problem solving as a result of modelling tutors’ approaches of facilitating design review conversations in their architectural journeys (Stevens, 1998; Fisher, 2012). Students practising self-directed learning is a virtue for lifelong learners. Self-directed learning occurs when students conduct and evaluate their learning journeys themselves. Being self-directed does not mean that their learning is highly individualised in isolation. Students can work in self-directed ways while engaged in group-learning settings (Brookfield, 2009). Inculcating a culture of self-initiated peer-to-peer learning can strategically respond to the international trend of funding cuts that decreases to the one-to-one student-tutor contact time (Tucker, 2016; Wallis & Williams, 2012).

2 A Future Built on Collaborations

Physical commodity and natural resources can no longer sustainably drive our economies (Powell & Snellman, 2004). In developed capitalist economics, production of knowledge, technological output and dissemination of information are deemed the main drivers. With the imminence of the artificial intelligence-driven Fourth Industrial Revolution, students of today will be journeying into a super-complex workforce. Educational theorist Ronald Barnett projects a world that exhibits global characteristics of challenges, turbulence, contestability and unpredictability (Barnett, 2000). Unlike the previous Industrial Revolution, the latest iteration shifts away from the emphasis of technical capabilities, mechanised and procedural skills to the acquisition of soft skills in supporting effective communications and collaborations. Soft skills depict capabilities of negotiation, competencies in their emotional intelligence, empathic and critical/creative thinking is considered paramount for a future collaborative workforce (Schwab, 2015).

The landscapes of future architectural practices must react to these disruptions. Prevailing narratives of starchitects celebrated as singular creative individuals, rather than being in collective enterprises in architectural pursuits (Till, 2018a) are losing relevancies in our current time. The architect’s role is constantly evolving from a siloed, individualistic practice of the master designer to the collaborative team player. Practices have to stay nimble and highly adaptive in challenging situations in the future (Duffy & Hutton, 2004; Jamieson, 2011). Bryant, Rodgers and Wigfall (2018) identified four main predominant trends of emerging modes of practices and the common denominator amongst them, is that architects are redefining and diversifying their traditional roles to working outside the realm of building as products. Turner Prize-winning group of designers and artist of Assemble and Architecture 00 are recent exemplars of such alternative architectural practices. Research agency, Forensic Architecture, expands the influence of architectural thinking and techniques working alongside artists, filmmakers, software developers, investigative journalists, archaeologists, lawyers, and scientists (Forensic Architecture, n.d.). This research group have since produced ground-breaking video graphic evidences presented in political and legal forums, truth commissions, and
human rights reports. Success in such interdisciplinary collaborative environments relies heavily on an open/growth mindset, building upon the foundations of soft skills and effective communications.

3 Mechanisms in the Design Studio

Curriculum reviews are frequent affairs in faculties. Architecture schools have responded enthusiastically to the imminence of the Fourth Industrial Revolution by equipping the latest state-of-the-art facilities, robotics and virtual reality technologies into their pedagogy to address the tool-sets of imminent design trends and inclinations - the hardware of architectural process. As expounded, having strong interpersonal, communication and collaborative traits are valuable in incubating new modes of cross-industry practices. Educators can design their studio learning experience as a pedagogical strategy aiming to inculcate soft skills (software) broadening their mental capacities in preparing students’ journey into an uncertain future (Ostwald et al., 2008; Burke et al., 2016). After all, education is about character building, empowerment, enablement and the transformation of the individual for them to intervene in this world (Till, 2018a).

Design studios are widely acknowledged as the pulse in architecture education worldwide. Weekly formative reviews in design studios typically involve students working on their design projects in the studio individually, in teams or groups. Typical scheduled contact hours are 2 to 3 hours per week. If students to discuss their designs in progress. Alternative forms of pedagogical approaches during formative reviews include individual pin-up or group reviews. Nevertheless, these formative review conversations still adhere to the hierarchical one-on-one teaching between the studio master with the student with a studio master at their desk (Goldschmidt, 2002; Webster, 2004; Mewburn, 2009; Goldschmidt et al., 2010; Tonkinwise, 2011; Liow, 2016). This pedagogical approach is commonly known as the desk crit. Desk critics’ one-on-one mode of teaching is widely preferred in architecture schools (Goldschmidt, 2002; Liow, 2016; Tonkinwise, 2011).

The studio pedagogical approach is such that design solutions to a singular problem are deemed to be endless. The design tutor can latch on to these instabilities of the design process to foster collaborative mindsets and mental resilience with their students in a team environment. Can tutors explicitly introduce attributes required for successful collaborations? Unlike, the inculcation of soft skills and the impartation of successful collaboration techniques can be a challenge to teach in seminars or lectures. Can students learn how to collaborate by mimicking their tutors? Probably. It is argued that design tutors could facilitate students’ learning with such qualities and thus, potentially to be latched on by students by modelling these values and behaviours in their lives (Stevens, 1998; Fisher, 2012). While researchers advocate the importance of collaboration in our curriculum and teaching engagements (Tucker & Rollo, 2003; McPeek, 2009; McPeek & Morthland, 2010; Tucker, 2016; Wilson & Zamberlan, 2017), institutions had garnered little repercussions. Many high-performing research schools are seldom equally concerned with the teaching-research nexus (Ostwald et al., 2008).

3.1 One-on-One Design Studio Pedagogical Model

As design professionals pride themselves as agents of change advancing their respective fields, it is curious why architects are lukewarm towards architecture education by depositing their faith through repeating the same studio pedagogical formula from the 20th century. Although the site of architecture education progresses from medieval work-sites, Beaux-Arts’ studios, Bauhaus’s workshops to the widely adopted Unit System, the revered one-on-one master and apprentice model of teaching remains unchallenged to date. The envisioned spontaneous dialogues, negotiations and discussions of an ideal design studio environment unconsciously slide back into the re-adoption of the Beaux-Arts apprenticeship model resulting in a dictated and regimented learning environment. This monodirectional design review conversation is a worrying aspect of our studio pedagogy.

Architecture schools need to question the relevance of such instructional and procedural teaching methods inherited from incarnations of the previous industrial revolutions. This unchallenged pedagogical approach promoted Webster (2004) to strongly criticise architectural educators for failing to embrace a more student-centric learning, remaining stuck in the master and apprentice model of engagement. Goldschmidt (2002) investigated this phenomenon and discovered that, in this one-on-one mode of teaching, the tutors’ critique constituted 62% of the review session and intensified to 74% in sessions with two tutors! Kurt (2009) elucidated that generally in every review type (both summative and formative), the design review conversation is usually tutor-centred. Whenever design review conversations remain tutor-centric, students’ learning outcomes are disappointing. Students tend to depend on tutors for the generation of ideas and the resolution of their designs (Green & Bonollo, 2003). Sometimes, students may be interested in fulfilling the design tutor’s design advice blindly and might end up as an exercise in mimicking the tutor’s architectural styles and design methodologies. Tutor centred design review conversations potentially limit students’
creativity and prevent them from exploring their designs freely (Kurt, 2009). This master and apprentice relationship continues to exert an immense influence in today’s studio culture, often results in missed opportunities of advancing the fields in design and architecture. Figure 1 and Section 3.1.1 aim to illustrate key characterises of a typical one-on-one desk crit.

![Image of key characterises of a typical one-on-one desk crit review](image.png)

**Figure 1. Key characterises of a typical one-on-one desk crit review. (Liow, 2016)**

### 3.1.1 Keys Characterises of a Typical One-on-One Desk Crit review

- A *Sign Up* queuing list ensures the review sequence.
- Minimal opportunities for cross-pollination and interaction. Predominately a one-way dialogue.
- Competitive students might hog the tutor for up to 40 minutes.
- Less motivated students may disappear during mid-day
- Lack of active participation from fellow peers. 2-3 students may gather around the table and not participate as active contributors but as passive learners waiting for their turn to consult.
- Breeding of competitive individuals. (Liow, 2016)

### 3.2 Team/Group Work Studio as a Collaborative Pedagogical Model

Educators recognise that learning in teams/groups theoretically leads to students’ development of interpersonal and critical thinking skills (Gokhale, 1995; Dochy, Segers & Sluijsmans, 1999). Diving into the literature pertaining to collaborative practices in the academic design studios reveals subtle differences in their definitions between *group work* and *teamwork*. Tucker, an authoritative figure in studio pedagogy research, clarified that the main difference between teamwork and group work in the design studio is that, for teamwork, students jointly work on a singular assigned project where members actively contribute to team cohesion and task achievement. While group work, students worked separately on different aspects of a project/task and then combine their work, often with limited attempts at integration (Tucker, 2016). Both methods of collaboration are characterised by students working towards one unified submission sharing the same academic outcome (Richard & Catherine, 2006; McPeek, 2009; Kamalipour et al., 2014; Pawson, 2016; Rodriguez et al., 2018). Even working together under the guise of collaborative assignments, educators cannot guarantee that students had communicated well to reap the benefits of developing their non-cognitive skills working in a group (Dillenbourg, 1999). Collaboration assignments usually occur in the beginnings of the design project as a formative assignment, i.e. site analysis and precedent studies which capitalise on students working together. This format of working in groups ceases when their individual design project begins.
4 The Current Study - Formative Design Reviews as a Collaborative Act

While a collaborative learning environment is universally lauded as a useful model for learning, collaborative assignments in the design studio conventionally refer to student groups/teams being stakeholders of a single deliverable, sharing the same grade. Deviating forms of collaborative pedagogical strategies during formative design reviews are sporadically examined. This paper reports on an action-research in which an experimental Collaborative Team Learning – CTL (treatment group) is infused into the day-to-day formative reviews contrasting against the ubiquitous one-on-one studio – OOO (control group) for one academic year.

The research questions examined for this study include:

1. Would students learning in a CTL environment garner positive effects on their learning experience and thus, influence students’ academic performance and retention?

A simple hypothesis is that with positive learning experiences in CTL, associations would surface between their respective pedagogical frameworks with academic achievements. CTL students are anticipated to have lower attrition compared to OOO students.

2. Would CTL help to increases the frequencies and effectiveness of students’ self-directed peer-to-peer learning outside official studio hours?

This paper speculates that OOO students inducted in an individualistic learning environment would register lower frequencies of peer-to-peer discussions. Conversely, students modelling of CTL’s strategy of cross-pollination and therefore, inculcate routines of self-initiated group discussions. The effectiveness of their peer-to-peer learning is primarily correlated through the analysis of their academic performance.

4.1 Experiment Methods – Team Size, Tutor Allocation & Structure of Assignments

This study is centred on first-year architecture students of 17 to 18-year-olds, who had embarked on a difficult transition from the logical STEM curriculums of high schools into the uncertainty and idealistic nature of an architecture school. The cohort of 110 students is randomly distributed across three studios as illustrated in Figure 2. The design brief is identical for all across the academic year. Twenty-six students from Studios A and B were facilitated in a CTL approach, and the rest of the cohort are taught in the traditional OOO desk crit format. A maximum of 1:14 teaching ratio is maintained throughout the cohort with contact times of 8 hours per week, divided into two sessions of 4 hours each. Students in the CTL group initiates their grouping and are paired with a fixed tutor. This strict pairing is in contrast with the OOO group as students can consult from any tutors in their studio via a sign-up list.

![Diagram of studio distribution](image)

*Figure 2. Overview of the cohort distribution and context of CTL.*

The freshmen’s design projects were conceived to cover a wide range of fundamental architectural sensibilities from site studies, architectural/environmental strategies, tectonic expressions to structural and constructions elements. The complexities of these assignments ramp up from the resolution of a tectonical sculpture as Foundation Exercise 1, a WW2 memorial as Foundation Exercise 2 to the Final Project of a single detached dwelling unit.
4.2 Experimental CTL Pedagogical Framework

Traditional education programmes are (unintentionally) orientated towards a competitive and individualistic climate of learning (Emmitt, 2009). Figure 3 illustrates how CTL’s pedagogy departs from both one-to-one desk crits as well as the established mechanics of team/group work. As a counterpoint, a typical scenario of CTL is that tutors guide students as a neutral facilitator that optimistically leads to less dictative review conversations. Design decisions of individual students are occasionally collectively made as a team and, students being aware of one other’s progress helps in the pacing of their design. This shared learning environment thrives on students’ camaraderie and finds encouragement within the uncertainties of design.

The intensity of the tutor’s intervention and drawing of questions from students decreases towards the end of the academic year as reflected in Figure 4. CTL’s diminishing level of prompting questions contrasts with OOO’s consistent level of engagement with tutors domineering discussions. It is projected that CTL students, towards the conclusion of the academic year, would have modelled the tutor’s approach in promoting and asking relevant questions. Active learning is a key component as tutors consciously orchestrate these formative conversations, engaging students as means to instil collaborative mindsets. The design tutor is both an actor and the orchestra conductor. CTL’s learning environment aims to breed moments of Cross-Cohort/Studio Pollination with collaborative tasks, illustrated in Figure 5.
4.3 Data Collection
Following submission of the final assignment of the academic year, students were invited to complete a paper-based questionnaire. They were informed that their participation was voluntary and would not affect their grades. This exercise was administered before their final results were released to ensure that their replies remain objective. There were four questions, the first as a Likert scale question asking about their learning experience, with a 5-point Likert scale from (1) very negative, (3) neutral to (5) very positive. The students were asked to reflect if they had received sufficient guidance (duration of tutor-student time, qualitatively) and to ascertain if their learning journey has been explorative, encouraging and engaging.

The next two questions were structured as open-ended responses so that students could provide a written reflection of their learning experience and suggest potential improvements. The questionnaire ends with a Yes/No question that seeks to uncover the frequencies of students’ self-directed peer-to-peer learning. Students would answer yes if they have met up with 2-3 other peers to discuss the progress of their design project at least three times per week outside allocated studio contact hours without the tutor’s facilitation.

5 Results
This primary research aim is to uncover various after-effects of learning in both OOO and CTL after one academic year. This section is broken into four sub-sections – 5.1) Academic Performance, comparing the end of the year scores of both groups of students, 5.2) Learning Experience, the breakdown of the data collected through the 5-Likert scale question. 5.3) Frequencies of students’ self-directed peer-to-peer learning outside official contact hours. Lastly, 5.4) Cohort Attrition, to uncover if their experience in their respective design studio’s pedagogical framework has any correlation to student retention. The response rate for the questionnaire was 85% with 94 students after seven cases of non-participation and nine attrition cases.
5.1 Academic Performance

An analysis was conducted to uncover any correlation between academic performance and the studio pedagogical framework between OOO and CTL group. A key finding, as hypothesised, is that CTL students outperformed OOO students with their academic grades. Figure 6 reveals that within the top 10 performers, six students were taught in CTL as opposed to 4 OOO students. Students from CTL are more likely to perform within the top 50th percentile with 80% of the 26 students contrasting against 38.2% of the 68 OOO students. 61.7% of students from OOO performed within the lower 50th percentile against 19.2% of the CTL students. No students from CTL fell into the lower 25th percentile. The lowest performing student from CTL achieved an academic score of 70% which not far off from the average cohort score of 73%. The mean scores from the CTL group are 72% with the OOO group at 69%.

5.2 Learning Experience

Figure 7 provides an overview results for the 5-Likert scale questionnaire seeking reflections on their learning journey. Majority of the CTL students, at 42%, gave a rating of 5 while the majority of OOO students, at 38%, gave a rating of 4. 69% of the students from the CTL felt that their experience was positive (Rating of 4 & 5) compared to the 56% of the OOO students. Comparing within the very positive (Rating of 5) band, there are more students in the CTL group at 42% as compared 18% of the OOO students. Surprisingly, almost one-third of the participants (27% from CTL & 31% from OOO) remained neutral about their learning experience.
Figure 7. Breakdown of the 5-Likert scale question on student’s learning experience

Figure 8 further analyses student’s positive learning experience (Rating of 4 & 5) to seek out any correlations between their academic grades and learning experience. With a comparable sample size of about 12 students from both groups (Rating of 5), 100% of CTL students scored above the 50th percentile of the cohort as contrasted with the 42% of the OOO students. Students from OOO are more likely to fall within the lower 50th percentile of the cohort with 58% and from the same group, 33% in the bottom 25th percentile. 73% of the CTL students scored within the top 25th percentile as compared to the 17% of the OOO students in the same scoring band. A similar trend can be observed for students who had a positive experience (Rating of 4).

Figure 8. Breakdown of academic performance for students who had positive experiences

5.3 Frequencies of Students’ Self-Directed Peer-to-Peer Learning

The social dimension of building supportive friendships in a studio is a critical aspect of the students’ learning process. (Degregori, 2007) An engaging learning environment in small groups can nurture relationships. This section seeks to uncover the frequencies of students’ self-directed peer-to-peer learning without the guidance of their tutors. The results revealed that the majority of the cohort (84%) discussed their projects with their friends outside the formalised contact hours of at least three times per week. The findings differ from the hypothesis that OOO students would register lower frequencies of peer-to-peer discussions. Surprisingly, there are not any significant disparities between the CTL group (85% - 22/26 students) and the OOO group (84% - 57/68 students) as illustrated in Figure 9.
5.4 Student Attrition
The cohort’s attrition rate (9 students) revealed no improvements from the previous academic years’ average of 10%. Referencing from Figure 10, seven attrition cases originate from the OOO group. Five OOO students cited having lost interest in the programme with two students who developed mental health issues relating to stress. In contrast to the CTL group, only two students left the programme with one student suffering from physical health issues and other citing depleting interest.

6 Discussions
This section aims to understand the repercussions of learning in both OOO and CTL groups. The most compelling finding is the close correlation between students’ academic performance, learning experience and attrition to their studio pedagogical framework.

6.1 Academic Performance and Learning Experience
Most noteworthy, CLT students’ academic performance is observed to have led to positive repercussions. This phenomenon may be explained by the student’s collaborative learning experience in CTL. Majority of CTL students have indicated a very positive learning experience (rating of 5) of having the tutors sufficiently facilitated their design process. Even with an average contact time of 35 minutes per student weekly, CTL students felt that their tutors had engaged them adequately and aided their design process in a team learning environment.

Students’ approval of their learning experience does not equate to excelling in their academic performance as illustrated in Figure 8. Benefiting from CTL’s strategy to capitalise on the dynamics of learning in teams, CTL students reported enjoyable experiences building rapport with each another. Friendly competition keeps the students motivated during trying times. Exchanges of constructive criticisms in an intimate setting without the fear of offending their peers are strongly valued. With sufficient guidance from their tutors, the students sometimes take over the review sessions. One particular student enjoyed this aspect of collaboration reflected: “While spending time cracking my brains for an alternative solution after critiquing our classmate’s projects, I had unconsciously thought of and found solutions for my own” (ref participant 08). At the end of the academic year, the students reflected that they have learnt to communicate, negotiate and enjoyed the collaborative learning atmosphere of CTL. CTL students revealed that they grew to be confident and intrigued by the design process in their projects in a collaborative learning environment.

One rationale for OOO students’ unfavourable ratings of their learning experience is the competitive queueing system. OOO Students collectively remarked: “I hated the queuing list. It is so competitive! I wanted to join the list many times but was discouraged after seeing the [length of the] list!” (ref participant 43) and “It is very tough for me to get a tutor
to discuss with me! The queues have started since early morning, and the review session can take up to one hour for each student!” (ref participant 65) Students acknowledged that the queue system inevitably causes tensional moments in their learning environment. OOO students predictably echoed that the studio atmosphere was individualistic and competitive.

6.2 Self-Directed Peer to Peer Learning
The frequent occurrence of such self-directed peer-to-peer learning for OOO students strangely does not correlate with their academic performance. On the contrary, the improved academic performance of CTL students seems to suggest that their peer-to-peer engagements were more effective even without the tutor’s prompting and interventions. The better performance from CTL is likely attributed to their collaborative learning experiences, observing the tutor encouraging cross-pollination and students re-enacting and modelling these review conversations on their own. These findings strangely compliment and contradict the experiment by Ghassan & Bohemia (2015), experimented with a student-led pedagogical model in which tutors purposefully maintain their distance as to encourage autonomy. Students construct conversations and outcomes primarily via discussions with their peers. They reported that in the absence of the tutor, students enjoy critiquing each other’s works informally. The findings from this paper partly align with Ghassan & Bohemia’s deduction that students from the OOO group are likely to struggle with the decision-making process without a tutor-led environment. CTL Students appears to be able to overcome this challenge without the tutor’s intervention by achieving better grades and learning experience.

6.3 Student Attrition and Academic Resilience
Christudason (2003) had reported that peer-to-peer learning situations could help to foster greater psychological well-being, social competence and communication skills. As a by-product of the shared learning environment, students cultivate close and supportive friendships purportedly build students’ academic resilience (Graber, Turner & Madill, 2016). In this context, Academic resilience refers to students achieving good educational outcomes despite adversities Cassen, Feinstein & Graham, 2009). Attrition is observed to be lower at 22.2% (2/9 students) for CTL. This phenomenon strongly suggests that by having that collaborative environment inculcated during CTL’s design studio builds emotional support and resilience in trying times. The majority of the attrition cases originated from the OOO group can be attributed to their hierarchical one-on-one, master to apprentice learning experiences. During their exit interviews with the level coordinator, recurring issues of the one-on-one pedagogical framework (discussed in 3.1.1), were identified as the root causes. Attrited OOO students regularly cite the lack of contact time with their tutors due to the long waiting list, being confused during design stages and constantly working alone in their studios as their reasons for quitting.

6.4 Limitations
The basics of comparison of students’ learning experience might be equivocal due to unbalanced sample size. As this research is carried on with freshmen students, their opinions might be inaccurate as they are inexperienced in other studios’ pedagogical frameworks to form the basis of comparison. A positive studio learning environment, which rests on the keystones of formative review conversations, is particularly contingent on design tutors’ pedagogical and communicational skills (Goldschmidt, Hochman & Dafni, 2010). Further research might explore having that same tutor teaching in CTL and OOO as the constant variable, for future comparative studies. The long-term repercussions of the CTL may worthwhile to be researched and documented in a longitudinal study to understand and seek out correlations between learning in a CTL framework and academic resilience.

7 Considerations and Conclusions
Architecture’s studio pedagogical framework today continues its struggle to shake off the ghosts of the competitive and stressful learning environment inherited from the medieval work-sites, Beaux-Arts’ Studios, Bauhaus’s Workshops to E A A Rowse’s (Architectural Association) Unit Systems. The current pedagogical model of the Master and the Apprentice dictating the learner’s design approaches and outcomes resulting in an individualistic and competitive environment is particularly worrying. OOO’s limited potential in preparing students journeying into emerging modes of future practices centred on effective communications, emotional intelligence and negotiations must be challenged. Furthermore, creative work in the 21st century calls for ways of learning which encourage participation and dialogue rather than judgment and discipline (Brown & Godlewskei, 2014).

This study questioned the relevancies and identified limitations of the one-on-one formative pedagogical framework of our design studios in breeding future collaborative practices. While collaborative studios in academia are nothing new, this study prototyped an alternative form of collaboration that hinges on tutors facilitating in heterarchical
studio pedagogical framework. The explorative nature of this research revealed early findings which illustrates CTL’s positive correlations with students’ learning experience and improved academic performance. Although this cohort of students frequently engaged in self-directed group studies, the effectiveness of student’s self-directed peer learning can be positively associated with the academic performance of CTL students. Further studies are required to validate this phenomenon. CTL’s lowered attrition rates compared to OOO proves to be advantageous in this era of reduced funding. These findings will add to a growing body of literature that argues for the design studio pedagogy to be relevant in the 21st century’s context of constant change.

Despite breaking new grounds in the field of architecture and design in recent years, educators rely on the trusted pedagogical model inherited from the previous incarnation of industrial revolutions. Curiously, inquisitive architects and designers heading design studios are mostly apathetic in designing an appropriate and relevant pedagogical framework that fosters graduates in launching alternative modes of practices. As Jeremy Till had frequently highlighted – architecture education is [indeed] deeply conservative (Till, 2018b).

References


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**About the Author**

Zhengping Liow is a lecturer in Architectural Design at Singapore Polytechnic. He is actively developing his research expertise on formative reviews in design education. Ping leads as the level head of the freshmen year and as the pedagogy lead for three design courses. Ping works on his manuscripts almost anywhere whenever time permits, and he is on twitter too! @ZhengpingLiow