Despite its long history, architecture education remains under-theorised. Design educators’ faith in the ubiquitous Master and Apprentice (M&A) pedagogy is increasingly worrying where knowledge is tacitly transferred in asymmetrical power structured environments through the ‘Hidden Curriculum’. Some students thrived. While some did not. Were some learners grittier than others? Grit (passion and perseverance for long-term goals) was often used as predictors of academic success. The experimental heterarchical Collaborative Team Learning (CTL) studio pedagogical culture departs from the ‘Mystery-as-Mastery’ authoritarian one-on-one (OOO) pedagogy, characterised by the tutor-induced cross-pollinative peer-to-peer formative reviews in normalising daily ‘setbacks’ relating to their individual projects. The three-year longitudinal research explored possibilities of inculcating Grit capitalised on their first-year’s CTL architecture studio experience. Inferential statistics revealed that both CTL and OOO learners failed to register positive growth in their Grit despite CTL’s significant outperformance during their first year. This is a timely study of exploiting design education’s ambiguous and iterative nature in investigating the viability of instilling learners’ Grit in preparation for an increasingly uncertain future.

Keywords: Non-hierarchical Studio Pedagogical Culture; Collaboration; Grit; Hidden Curriculum; Student Engagement

Introduction

The most dangerous phrase in our language is ‘we’ve always done it this way.’ – Grace Hopper

Despite its long history and significance in design education, the concept of the Design Studio remains elusive, with no single definition that accurately describes it (Schön, 1987). Cultural and dialogical pedagogic activities (Schön, 1984; Biggs, 1999) are embedded in a socialised learning environment (Crowther, 2013; Owenly, 2013) that deepen students’ understanding of design that often led to the enculturation of students into the ‘desired’ behaviours of the profession (Crowther, 2013; Dutton, 1987; Stevens, 1998; Webster, 2005; Wilson, 1996) through the Hidden Curriculum. The creative design process is often structured by ambiguities and uncertainties (Orr & Shreeve, 2017; Tracey & Hutchinson, 2016) that warrants differentiated contents and studio teaching methods amongst different institutions (Ledewitz, 1985). Nonetheless, the authoritarian Master & Apprentice (M&A) One-on-One (OOO) studio pedagogical culture remains deeply pervasive (Goldschmidt, 2002; Goldschmidt, Hochman & Dafni, 2010; Liow, 2016; Mewburn, 2009; Tonkinwise, 2011; Webster, 2004; Webster, 2005) through the decades. The Studio Culture often referred to daily ‘experiences, habits, and patterns found in the design studio’ (Koch, Schwennsen, Dutton & Smith, 2002), which is substantially influenced by tutors’ teaching methods (Ersine Masatlioglu & Parker, 2017). Design tutors hired straight from the profession with limited pedagogical training bring along value systems that reinforce the black-boxed “Mystery-as-Mastery” teaching practices (Argyris & Schön, 1974; Banham, 1990). Tutors are purported to be hesitant to demystify the design process as to maintain asymmetrical M&A power relations heavily dependent on implicit knowledge transfer. Tacit knowledge, which manifests itself as the Hidden Curriculum, is often predicated on tutors’ debatable aesthetic
preferences, intuitions, spatial perceptions, problem-solving techniques (Venkatesh & Ma, 2019), motivational and ethical values of the profession/discipline (Dutton, 1987). The responsibilities of absorbing tacit knowledge are pushed over to the unsuspecting learners, further aggravating students’ anxiety with design education’s Pedagogy of Uncertainties/Ambiguities. Failure to adhere to the tutor’s directed instructions (often late in the design process) or difficulties in keeping up with unrealistic expectations has increasingly left earnest learners struggling with mental health issues. The prolongation of late nights, anxieties and depression (AIAS, 2008; Kirkpatrick, 2018; Leon, Linova, Squires, & Daros, 2014; RIBA, 2017; RIBA, 2018) are often perpetuated in the oppressive OOO M&A studio learning environment.

A handful of students strangely thrived under oppressive conditions while the vast majority do not (Kirkpatrick, 2018). The survivors were deemed to have successfully enculturated/socialised into the system by learning the rules of the game (Webster, 2005). Most students endured by keeping to their guns at the expense of their mental health. Were some students grittier than others? Grit is a malleable construct (Bashant, 2014; Fitzgerald, 2016; Weisskirch, 2018) defined as ‘passion and passion for long-term goals’ (Duckworth, Peterson, Matthews, & Kelly, 2007). In the context of this study, Grit extends beyond students coping well with the presence of stressors to the ability to ‘recover and excel’ from the daily ‘design setbacks’ experienced in their design projects. Grit was often validated as a reliable predictor of academic performances and retention (Duckworth et al., 2007; Duckworth & Quinn, 2009) and corresponded with high frequencies of ‘Deliberate Practice’ (Duckworth, Kirby, Tsukayama, Berstein, & Ericsson, 2011). Deliberate Practice focuses on activities with specific goals of improving performance and working on resolutions targeting specific weaknesses (Ericsson, 2004). Although the construct of Grit has been extensively researched, limited attention was received in design/creative education (Rojas, 2015).

This longitudinal study examines whether Grit can be spontaneously inculcated as a ‘by-product’ of the iterative design process and driven by the hypothesis that the alternative non-hierarchical Collaborate Team Learning (CTL) studio pedagogical culture as a catalyst for inculcating Grit. As opposed to the authoritarian OOO M&A mode of engagement, the CTL pedagogy is fuelled by the tutor-induced Peer-to-Peer (P2P) cross-pollinative reviews in a bid to normalise the daily ‘design setbacks’ in a first-year architecture design studio. Moreover, it has been advocated that collaborative learning is a viable way to increase students’ grittiness (Chang, 2014). The design pedagogy of students’ repetitive and laborious efforts of design refinement shared a similar mechanism with Ericsson’s (2004) ‘Deliberate Practice’, often setting up informal peer support systems akin to Wenger’s (1999) Communities of Practice within the socialised design studio.

Inferential statistics are carried out in investigating possible relationships between these variables. This paper examines the possibilities of building Grit to be validated alongside CTL’s academic outperformance over their OOO peers. Strangely, associations between grittiness and academic scores are revealed to be weak with a downward trend. On a brighter note, CTL students are reported to have outperformed their OOO peers for their first year of study. After CTL learners formally transit into an OOO pedagogy in their subsequent years, the differences between their academic scores between both groups are registered to be insignificant. This finding suggests that CTL’s dismantling of the OOO M&A studios’ asymmetrical power structures can yield positive academic outcomes only when their tutor was actively facilitating. Questions on CTL studio pedagogical culture’s efficacies in instilling the non-cognitive trait of Grit over an extensive period remains inconclusive.

Bridging the transition of first-year students growing up with closed-ended curricula to learning design through an ambiguous design process is critical, as their first-year performance has shown to be a reliable predictor of their ongoing academic success (Crowther & Briant, 2020). This research contributes to the scholarship of teaching and learning in design education by broadening our perspectives towards an alternative non-hierarchical team-based design pedagogy relevant for an increasingly collaborative future.

**Faithfulness to the Master and Apprentice Studio Pedagogical Culture**

Design Studio’s centrality in design education remained undisputed amongst educators. However, the importance of a sound pedagogical process is often neglected as studios are increasingly obsessed with design outcomes (Till, 2003). The authoritarian OOO M&A model inherited from the Beaux-Arts continues to perpetuate in studios today (Crowther, 2013; Goldschmidt et al., 2010; Liow, 2016) where tutors unconsciously oppress and demotivate students, negatively impacting their performance (Austerlitz et al., 2008). Studio pedagogy is often tutor-centric, contrary to popular beliefs of it being a student-centred learning model. While design tutors play critical roles in influencing the learning environment, teaching practises are often relegated to intuitions by reproducing their own learning experiences (Grasha, 1996; Goldschmidt, Casakin, Avidan & Ronen, 2014; Rapoport, 1984; Moore, 2001).
Design Education’s Pedagogies of Uncertainties/Ambiguities (Crowther, 2013; Orr & Shreeve, 2017; Temple, 2018; Tovey, 2018) have unwittingly endorsed Argyris and Schön’s (1974)’s (1974) M&A’s ‘Mystery-as-Mastery’ tacit teaching model comparable with Olson & Bruner’s (1996) notion of ‘Folk Pedagogy’. ‘Folk Pedagogies’ are situated within an intuitive realm where teachers rely on implicit theories, one-way dialogues where interpretation is restrictive and relies heavily on mimicry as a pedagogical strategy (Olson et al., 1996). The M&A’s authoritarian dialogical exchanges instil non-cognitive dispositions, value systems, aesthetical tastes, and beliefs (Dutton, 1991) in adherence to professional practices’ exploitative and oppressive behaviours into the minds/behaviours of learners. These value systems are enculturated through the ‘Hidden Curriculum’ in the design studio.

The Hidden Curriculum and the [Enculturated] Studio Pedagogical Culture

The Hidden Curriculum that lurks beneath the visible structures of design studios is seldom discoursed (Webster, 2008), especially its immediate impact on the studio pedagogical culture (Ersine Masatlıoğlu & Parker, 2017). The socialised learning environment cannot be rationalised as neutral grounds for knowledge transmission (Jackson, 1968) with underlying implicit sets of influences operating within organisational structures and cultures (Hafferty, 1998). The M&A’s OOO pedagogical modus operandi of the tacit Hidden Curriculum remained profoundly pervasive, espousing the tutor-centred ‘Mystery-as-Mastery’ phenomenon (Argyris & Schön, 1974) of exerting their power and imaginative expressions on learners. The attitudes and value systems perpetrated by the M&A’s Hidden Curriculum causes immense stress, leaving students being neglected and suppressed (AIAS, 2020). Students’ negative experiences, excessive strains and confusion with the iterative process often attributes to the hierarchical M&A implicit teaching methods with high workload expectations.

The lack of student agencies, wearing badges of honour of glorifying sleep inadequacies, being confined to limited creative expressions (AIAS, 2020) are daily anecdotes in the studio. Learners’ discretion to exercise their design decisions after experiencing ‘design setbacks’ is rarely evident, as they are ‘highly encouraged’ to stick to their tutor’s solutions for fear of jeopardising their grades (Liow, 2021). Design competencies are superficially developed through mimicry rather than broadening students’ exposure and confidence in their design process. Such teaching methods are detrimental to beginning designers’ education in finding their feet after setbacks and their identity through the self-discovery/reflective design process. Learners’ mental wellbeing consequently takes a toll. Students’ motivation for burning through late nights is fuelled by peer pressure and anxieties of being publicly humiliated in design reviews (Webster, 2005). With negative behaviours/mindsets instilled by fear and insecurities, the viral and toxic ‘cultural’ habits, indoctrinated through observing and enacting (Dutton, 1997) senior students’ working patterns, are astonishingly advocated by their tutors (Austerlitz et al., 2008).

Design and Medical pedagogies are similar in their investigative and evaluative methods examining learners’ proposed ‘contextualised’ strategies during reviews. Remarkably, one crucial trajectory prevalent in medical pedagogy research is to make these Hidden Curricula explicit. Mackin, Baptiste, Niec & Kam (2019) revealed that medical professionals’ lived experiences with the Hidden Curriculum often resulted in undesirable repercussions. Medical apprentices reported emotions of vulnerability, hierarchy, privilege and dehumanised, while positive traits such as navigation, negotiation and positivity were weakly echoed. These findings were comparable to the sentiments reflected by architecture students (AIAS, 2008; Kirkpatrick, 2018; Leon et al., 2014; RIBA, 2017; RIBA, 2018). The widespread failures of design tutors in making the tacit Hidden Curriculum unequivocal (Austerlitz et al.,2008) often led to tutors coercing learners to faithfully reproduce the dominant value systems and the beliefs of professional practices (Webster, 2005). While few students appeared to thrive under the M&A model, the majority do not (Kirkpatrick, 2018). Could it be that some students are just grittier?

The Curious Constructs of Grit

There is a growing interest in understanding students’ personality traits as predictors of academic success, retention and performance within the educational research community. The mindset of ‘Grit’ is one of them. Grit is defined as having ‘passion and perseverance for long-term goals (Duckworth et al., 2007)’, fuelled by resilience in the face of failures with a deep commitment for success (Perkins-Gough, 2013). A self-reflective 12 items ‘Grit Scale’ is a two-factor structured survey consisting of six questions to understand students’ Consistencies of Interest and another six, Perseverance of Effort (Duckworth et al., 2007).

Duckworth et al.’s (2007) study amongst Westpoint Military cadets revealed Grit’s positive associations with retention. ‘Self-control’ rather than Grit was revealed as a better predictor of cadets’ academic outcomes. The same 2007 manuscript also uncovered that grittier Ivy League students and Scripps National Spelling Bee
competitors (Duckworth et al., 2007; Duckworth et al., 2011) outperformed the less gritter ones. High levels of Grit seem to be beneficial for tasks that are difficult but are well defined. Grit is best inculcated in tandem with sustained ‘Deliberate Practice’ (Duckworth et al., 2011). Coined by Ericsson (2004), ‘Deliberate Practices’ are repetitive, purposefully targeted activities that one takes up voluntarily to address specific weakness in their endeavours. ‘Reflection-on-action’ to Develop Grit in the First-Year Design Studios Design students need to confident in embracing moments of ambiguity when tackling open-ended challenges. Learning design is a cultural change for beginning design learners, as they continuously yearn for clarities and certainties that vary from their prior learning curricula of closed-end problems (Austerlitz et al., 2008). Wood (2006) defined closed-ended problems when the following three conditions are met: 1) learners are familiar with the procedural methods, 2) data required in solving are provided, and 3) the desired outcomes are clearly stated. Beginning design students’ uneasy experiences in this complex cultural transition saw some failing to adapt (Austerlitz et al., 2008). Many first-year students consciously resisted negative emotions of ‘failures’ by subscribing to the fallacies of believing that they could excel simply by imitating or adhering to tutors’ instructions (Webster, 2008). Grit can only manifest in the face of challenges and pitfalls. It is essential for first-year tutors to facilitate in an empathic manner in bridging learners’ introspective thoughts by tactfully guiding them on how to capitalise on their ‘reflection-on-actions’ process meaningfully. Reflection-on-action occurs when students reflect on the design discussions after their review, during which new perspectives acquired will affect students’ experiences, guiding them in processing and structuring their emotions and subsequent actions (Schön, 1987). Furthermore, Korstange (2016) advocated that by engaging in reflective writing could spur the development of Dweck’s Growth Mindsets (an adjacent construct to Grit). Would the traditional design pedagogy of students receiving feedback, accompanied by moments of “reflection-on-action” and “deliberate practices” of imagining and targeting specific design areas for improvement, train students to be grittier? To date, there are limited studies conceived to investigate Grit’s relationship with students’ academic performance in design/creative education (Rojas, 2015). Prior research (Bush & Arnold, 2020) revealed weak associations between gritty students and improving scores in the context of tracking first-year Industrial Design college students.

Towards A Collaborative Team Learning Pedagogy Culture This research examined the effects of an alternative non-hierarchical Collaborative Team Learning (CTL) studio pedagogical model that recalibrates the asymmetrical powered structures of the OOO M&A model. The learning experience is conceived as a relationship-driven social constructivist environment where design knowledge is co-constructed in an interactive socialised context, internalised, and acted upon by individuals (Bruning, Schraw & Ronning, 1999; Amineh & Asl, 2015). As a catalyst to cultivate trusting relationships, CTL students select their teammates after bonding through activities during their orientation programme. The setting up of the desired cross-pollinative team-based ‘Community of Practice’ studio culture in negating negative emotions of ‘design setbacks’ (Liow, 2021), inculcating the malleable construct of Grit (Bashant, 2014), is intentionally structured through formative activities in the design brief. The design brief comprises staged interdependent design activities with explicit instructions as ‘safety nets’ (but with open interpretations), accompanied with ‘reflection-on-actions’ pointers to assist learners in reflecting on and examining their own and their peers’ designs. In contrast to the intuitive M&A’s ‘Folk Pedagogical’ method, CTL’s tutor-induced cross-polinative facilitation will be scaffolded by explicit prompts in the design brief with students working on both communal (not necessarily Group Projects) and individual activities. Design methodologies, workload and course expectations in the design brief demystify the ‘Mystery-as-Mastery’ folklore. Common milestones and expectations help to ensure that pertinent issues are discussed amongst students.
CTL embraces a dialogical approach to polemical discussions where personal assumptions and biases are challenged in a trusting learning environment with an equitable distribution of power. CTL Tutors take on the role of impartial facilitators since genuine discussions can only occur in non-hierarchical structures (Dutton, 1987) as illustrated in Figure 1. Tutors actively choreograph cross-pollinative peer-to-peer discussions of their individual design projects that contribute to the development of a gritty learning culture (Chang, 2014). These CTL studio’s pedagogical mechanisms transmitted as the Hidden Curriculum instils beginning design students’ positive and collaborative mindsets, which will turn the tides of the oppressive M&A OOO studio culture.

Research Design
The following sections expound on the Research Context, Research Aim and Questions, Hypothesis and Research Methods.

Research Context
This study is contextualised within the first-years’ design studios spanning one academic year consisting of four terms. The study involved 35 first-year, 17 to 18-year-old Generation Z Architecture students from a polytechnic in Singapore, with 16 (11 males and 5 females) immersed in the CTL studio pedagogical culture and 19 learners (11 males and 8 females) taught in the typical OOO M&A format. Students’ official contact hours were fixed at having weekly eight-hour studios with a maximum teaching ratio of 1:14. Students worked on an identical design brief and deliverable as a cohort system rather than the non-standardised autonomous Unit system. 84.2% of OOO (16/19) and 81.3% of CTL students (13/16) reported engaging in self-directed learning (SDL) P2P reviews with two to three peers at least three times a week, as reported at DP1. These SDL P2P sessions are held outside of formal contact hours without their tutors’ facilitation.

With reference to Figure 2, first-year students start with an explorative compositional exercise with Lines, Planes and Volumes as the overarching narrative for term 1. Term 2’s project comprises a small 10x10m structure comprising ergonomics and anthropometry challenges. The design of a single unit dwelling house straddles between Term 3 and 4 which students conceptualise the macro aspects of the design in the former term, and lead to their detailed construction drawings and in the latter studio term. The ‘Design Studio’ module is conceived as an integrative activity in which ‘Environmental Science’, ‘Building Construction’ and ‘Architectural Design’ Modules are simultaneously assessed during reviews. Students embark on designing a high-rise residential mid-rise tower in their second year and ends with a public project for their final year. After each project, learners were evaluated in a summative review. A panel comprised four to seven tutors with a joint assessment rubric accessing their creativities/resolutions of their design intentions, strategies, and technical strengths. Tutors’ scores were averaged and moderated to determine students’ final grades.
Figure 2. An overview of the Pedagogical Structure for the Architecture programme and the Data Collection Points.

Research Instrument: Measuring Grit

First-year students were introduced to the research project titled ‘Learning Experience in the Design Studios’ and informed that data would be collected over three years. The four data collection points for their Grit Scores and their respective Design Studio scores (Figure 2) were gathered from the level coordinator. The paper-and-pencil Grit questionnaire was disseminated to the learners before receiving their semester grades so that their reflective emotions would not be stirred by their academic performance. The ‘12 question Grit Scale’ (Duckworth et al., 2007) is deployed to assess students’ level of Grit. Participants rated 12 items, using the scale of 1 = not like me at all to 5 = very much like me. The Grit scale measured two subscales of six items each, Perseverance of Effort and Consistency of Interest. Sample questions for Perseverance of Effort are ‘I have overcome setbacks to conquer an important challenge’ and ‘Setbacks don’t discourage me’. The sample questions concerning Consistency of Interest are ‘I have been obsessed with a certain idea or project for a short time but later lost interest’ and ‘I have difficulty maintain my focus on projects that take more than a few months to complete’.

Figure 2 depicts the first data collection point (DP1) after 15 weeks of immersion in the design studio (end of Term 2). Rather than collecting immediately after enrollment, the delay allows first-year students to experience and transit from their previous ‘closed-ended’ educational structure to the ambiguity of the design studio. At the end of their first year, the second collection data point (DP2) represents a fundamental transition for CTL students to be coached with the OOO pedagogy for their subsequent years of study. DP3 and DP4 were held at the end of Year Two and Year Three. While many Grit researchers use a cross-sectional methodology, this study’s longitudinal nature with intermediate data collection points allows students to reflect on and possibly improve their Grit through periodic formative reviews. Multiple data points from the same participant may provide a clearer understanding of learners’ Grit for long-term goals.

Research Aim and Questions

The 3 year longitudinal research investigates relationships between learners’ Grit scores and their academic performances from both CTL and OOO studio pedagogical cultures. The central hypothesis of this study seeks to uncover if the inculcation of Grit can be naturally exploited within the iterative design process of constantly working and refining designs from everyday studio ‘setbacks.’ This research also asserts the CTL studio as a catalyst in cultivating students’ Grit, as exemplified by the tutor-induced P2P cross-pollinative dialogic pedagogy in creating close-knitted social support structures akin to Wenger’s (1999) ‘Communities of Practices.’ The following research questions are conceived to guide this study.

**RQ1**: Would the heterarchical CTL studio pedagogical culture accelerate the development of Grit from DP1 to DP2 (when compared to OOO students) and, as a result, academically outperform their OOO peers during their first-year study?

**RQ2**: Would CTL students continue to advance their Grit scores in the continued practice of self-directing cross-pollinative CTL behaviours and, thus, academically outperform their OOO peers even after transitioning
to the siloed M&A OOO reviews from DP2 to DP4?

Hypothesis and Method for RQ1 (Relationships of Grit and Academic Scores from DP1 to DP2)

**RQ1** hypothesises that CTL’s heterarchical pedagogical culture hastens their growth in Grit and, as a result, outperforms their OOO peers academically from DP1 to DP2. RQ1’s hypotheses are as follows:

**Null Hypothesis** - \( H_0 \): \( \mu_2 \) (Grit & Scores at DP2) - \( \mu_1 \) (Grit & Scores at DP1) = 0 and

**Alternative Hypothesis** - \( H_1 \): \( \mu_2 \) (Grit & Scores at DP2) - \( \mu_1 \) (Grit & Scores at DP1) > 0.

**Method for RQ1**: The first Paired t-test seeks to understand the Pre (DP1) and Post (DP2) differences of CTL students’ Grit of testing the CTL intervention’s efficacy. A Paired T-test is used to test the significant difference between two related means (Adeyemi, 2009) obtained in matched pairs and are thus dependent (Hsu, 2005). Paired T-tests are performed to assess the intervention’s effectiveness using values from a Pre-test and a Post-test. The second Independent t-test seeks out any significant differences in their academic scores at DP2 that would support the hypothesis that Grit’s increase is deemed positive by corresponding with CTL’s outperformance of their OOO peers. A resultant Probability level (p-value) of less than 0.05 will validate observations of having a substantial difference in the mean values. The relationships of both resulting p-values will help support or refute the premise that CTL’s positive instillment of Grit primarily correlates (statistically) with CTL students’ academic outperformance.

Hypothesis and Method for RQ2 (Relationships of Grit and Academic Scores from DP1 to DP4)

In the context of the socialised design studio, **RQ2** hypothesises that CTL students’ continual practices of informally self-directing their P2P cross-pollinative engagements as ‘Communities of Practice’ will accelerate their growth in Grit and consequently academically outperform their OOO peers. Hence, RQ2 is interested in the long-term implications of their first year’s CTL experience as they transit to the OOO pedagogy in their second year. RQ2’s hypotheses are as follows:

**Null Hypothesis** - \( H_0 \): \( \mu_2 \) (Grit & Scores at DP4) - \( \mu_1 \) (Grit & Scores at DP1) = 0 and

**Alternative Hypothesis** - \( H_1 \): \( \mu_2 \) (Grit & Scores at DP4) - \( \mu_1 \) (Grit & Scores at DP1) > 0.

**Method for RQ2**: With a similar framework of RQ1, RQ 2’s first Paired t-test seeks the significant growth of students’ Grit scores for CTL students from DP1 to DP4. The second Independent t-test aims to tease out significant differences in their academic scores between the two pedagogical groups (OOO and CTL) at DP4 with the hypothesis that CTL learners will academically outperform their OOO peers. The relationships of both p-values will aid in the support/refute of the premise of CTL’s continual inculcation of Grit (attributed to the frequent practice of cross-pollinative CTL self-directed P2P discussions) to be further substantiated with CTL’s academic outperformance.

Results and Discussions

The following sections discussed the results of the t-tests that attempted to draw relationships between students’ inculcation of Grit and their academic scores for the Integrated Design Studio (which consists of various architectural modules) in testing the hypothesis of capitalising on the iterative design process as a natural setting for developing their Grit between the ubiquitous OOO and the alternative heterarchical CTL studio pedagogical culture.
Results of RQ1 [Grit scores and Academic performance during their Year 1 Studies]

RQ 1’s observational period was from the middle of Year 1 (DP1) to the end of their freshmen year (DP2). Students’ first Grit measurement at DP1 revealed a minimal difference between OOO’s 3.382 and CTL’s 3.459 \( (p = .2954) \). Despite CTL students’ significant decline in Grit, they have significantly outperformed their OOO peers for both DP1 \( (p = .00469) \) and DP2 \( (p = .00004) \). CTL’s decline in their academic performance from DP1 to DP2 remained insignificant \( (p = .374) \). OOO students’ Grit remained relatively stable from DP1’s 3.382 to DP2’s 3.329 \( (p = .2743) \), but OOO’s grades plummeted significantly from 69.115 to 63.990 \( (p = .00060) \).

Unexpectedly, students’ Grit levels and academic scores decreased for both groups at the end of their first year.

Discussion of RQ 1
This research explores potential associations between students’ Grit and academic performances in an architecture design studio for first-year students participating in two different learning cultures. When Grit decreases for both groups, the broader assumption that Grit will be instilled as a by-product of capitalising from the iterative design process is invalidated. The first t-test reflected CTL student’s significant decline of Grit from DP1 to DP2, which has nullified the alternative hypothesis of CTL learners’ advancement in Grit compared to their OOO peers. This finding contradicts Chang’s (2014) proposition that collaborative engagements promote the development of Grit.

Having a Growth Mindset is an essential attribute among design students as it helps them navigate through the uncertain process in design disciplines (Dweck, 2008). The open-ended nature of design pedagogy requires an agile mindset capable of absorbing new information and criticism while evaluating its applicability to student’s own design. Could Grits’ perseverance, defined as ‘continued effort and determination’ (Cambridge Dictionary, n.d.), be a strong-willed construct obstructing the open-ended design process?

Beginning design students’ fixated mindsets with preconceived notions of appropriating ‘seductive’ images online (Liow, 2021) may not have felt the necessity for a rigorous process, thus negating the exercise and
development of Grit. Even with decreasing Grit, CTL students outperformed their OOO peers on both DPs, suggesting CTL’s pedagogical culture’s ability to yield academic benefits. Researchers have advocated that the social aspects of higher education are highly contributing to students’ success (Felten & Lambert, 2020). Having peers’ active and focused involvement in collaborating on another’s design process helps to ignite and sustain learners’ passion for their work (Perrewé, Hochwarter, Ferris, McAllister, & Harris, 2014). CTL’s tutor-induced peer support structure creates a studio environment characterised by high expectation with high support. The fostering of quality supportive friendships strengthen learner’s abilities in dealing with setbacks (Graber, Turner, and Madill, 2016) of the ambiguous design studios. CTL’s outperformance, which contrasts with their declining Grit, is intriguing. CTL students may have reflected on and given themselves negative, depressed self-ratings that were mistakenly associated with their laborious and rigorous design process. Hence, the narratives for the resulting disparity remains inconclusive. Future research should consider collecting and analysing qualitative data to uncover new insights into learners’ lived experiences.

OOO’s academic performance had curiously plummeted significantly from DP1 to DP2. Theoretically, OOO learners immersed in an M&A tutor-centred setting should outperform their CTL counterparts. During summative reviews, it was observed that OOO students appeared to be entrenched with the ‘closed-ended’ pedagogy of their prior educational system. OOO students are purportedly misled by assuming that their designs, being rigidly supervised by their tutors, is without flaws and does not require any improvements. Their unpreparedness to take ownership of their own design process by not questioning the tutor’s, as well as their underlying preconceptions and biases, were frequently uncovered during summative review’s Q&A. M&A tutors’ hunch in dispensing ‘certainties’ by providing visual references for students’ inspirations and adherence in clearing OOO students’ cloud of confusions (Green & Bonollo, 2003) are detrimental in developing learners’ confidence and perseverance for the ambiguous design process (Liow, 2021). This cushioned safety net, of having lesser occurrences of the design studios’ daily ‘design setbacks’, could be explained by OOO’s modest decline in Grit.
Results of Answer RQ2 [Grit scores and Academic performance from their Year 1 to year 3 Studies]

Figure 4. Result table for RQ2 with the two main comparative t-tests shaded in grey. 

As Grit is defined as having sustained passion and perseverance through prolonged periods of experiencing challenges (Duckworth et al., 2007), RQ2’s extended tracking spans from DP1 to DP4. CTL learners’ Grit scores maintained a gentle decline from DP1’s 3.459 to DP4’s 3.287 with a p-value of .1675 (but recovered from DP2’s dip to 3.187, resulting in a significant decrease) in their transition to an OOO studio pedagogical culture. CTL’s academic scores decreased from the DP1’s 75.737 to DP4’s 73.708 (p = .0916). Although the Grit of OOO students fell over the next 2.5 years from DP1’s 3.382 to DP4’s 3.357 (p = .4175), their academic performance improved from 69.115 to 71.706 (p = .0506). OOO’s academic scores at DP4 of 71.706 is closing the gap with CTL’s 73.708. However, their resultant p-value of .1347 revealed little significance. 

Discussion of RQ2

RQ2 investigates whether CTL students’ transition to the siloed OOO M&A desk crits would maintain their improvements in Grit concurrently with outperforming academic scores. As the negative trend in Grit and academic performance from DP1 continues, RQ2’s alternate hypothesis that CTL students’ academic outperformance is possibly due to increasing Grit and involvements in their self-directed P2P cross-pollinative practises is rejected. Cross-pollinative design discussions practised casually amongst CTL peers even after transiting into the OOO pedagogy (as revealed to the author during CTL’s focus group interviews) may not have been successfully bridged and facilitated through their senior years. This finding suggests that the tutor’s continual facilitation is required to ensure the continual reaping of CTL studio pedagogical culture’s benefits. The knowledge and confidence to ask relevant questions to spur the creative process require the maturity of the experienced mind. To encourage such behaviours, CTL’s choreographed cross-pollinative discussions enable the inculation of a positive ‘Hidden Curriculum’, in which CTL learners acquire competencies of asking questions by observing the tutor and their peers. This affirmative enculturation of inquisitive behaviours requires tutors’ constant scaffolding to be effective, as learners are likely to struggle with the questioning process without a tutor-led environment (Ghassan & Bohemia, 2015).
In comparison to their CTL peers, OOO’s decline in Grit was modest, particularly considering their improved academic performance at DP4. Their academic improvement suggests the successful enculturation of the OOO’s studio habits and culture characterised by strict compliance with the M&A instructive pedagogy. Beginning design OOO students who underperformed at DP1 may have begun the course optimistically by challenging the tutor’s instructions and not wholly conforming to the tutor’s wishes. After OOO students had reflected upon their grades, they might revise their strategies of ‘rebelliously questioning tutors’ and their underlying assumptions to the ‘adherence to strict regimens’ to ensure that their grades are not jeopardised (Liow, 2021). After all, senior design students are more acculturated to playing the M&A’s game of bluff by initiating surface-level dialogical reviews and blindly [re]producing solutions tailored to the tutor’s preferred design paradigms in return for good grades (Webster, 2005). Students putting on a veiled façade in exchange for grades through conforming to the tutors’ instruction is not novel. Braaten (1964), a psychologist, had noticed similar behaviours in architecture studios about a half-century before!

Validities of Self-Reported Measures
Any self-reflective measure’s accuracy should be analysed with caution. Researchers have uncovered weak positive correlations between student self-ratings and other measures (Sarin & Headley, 2002 & Brown, Andrade & Chen, 2013). In Asia, where cultural behaviours such as self-effacement (Kwok & Lai,1993) and humility are prevalent, students frequently reported depressed self-evaluations. Self-assessments’ validity is also highly dependent on the academic calibre as high achieving learners are revealed to possess a higher ability to perform self-assessments than low-performing peers (Sarin et al., 2002).

A Final Ditched Attempt Seeking Relationships of Grit and Academic scores
Merging all data collection points (DP1 to DP4) as a singular dataset representing the student’s entire duration with the institution, this section explored the possible correlation between students’ (both OOO and CTL) academic and Grit scores.

A ‘weak positive’ correlation of Grit with Scores ($r = 0.2046$) is reflected for the cohort in Figure 5a. Correlation for OOO students (Figure 5b) resulted in a ‘very weak positive’ relationship ($r = 0.1439$) while CTL learners’ correlation (Figure 5c) is ‘moderate positive’ ($r = 0.40300$). Although not an ideal ‘strong correlation’ by CTL learners, the moderate positive correlation does suggest Sarin et al.’s (2002) notion of higher calibre students’ abilities to conduct accurate self-assessments.

Conclusion
Mental health issues arising from the oppressive OOO M&A design studio are not novel predicaments (Braaten,1964; Kirkpatrick, 2018). Even after centuries, design educators have stayed lukewarm in experimenting with alternative studio pedagogies in challenging the pervasive authoritarian M&A cultural relations. Design tutors were generally unaware of the benefits of shifting the hierarchical line (Goldschmidt et al., 2014), and a lack of pedagogical training (Webster, 2005) has consistently left demotivated students in the ditch.

The focus of this research is to ascertain if the instillment of Grit is effective within the iterative design process, particularly in a heterarchical design pedagogical culture where the tutor-induced P2P cross-pollinative dialogic approach seeks to normalise daily ‘design setbacks’. Grit was discovered to have little correlation with both academic scores and the varying studio cultures. The consistent decline in Grit readings throughout the
2.5 years is perplexing. The insignificant relations between Grit and learners’ academic performance in a design studio presented in this study is echoed by Credé et al. (2017). According to Credé et al. (2017), ill-defined tasks that require both creativity and the willingness to abandon unsuccessful strategies may be counterproductive if students are gritty. Being too gritty might backfire against the iterative design process characterised by uncertainties and ambiguities. Although the concept of instilling Grit may appear to be less relevant in design education, tutor-induced cross-pollinative CTL pedagogy has successfully ripped educational benefits. To better understand learners’ lived experiences, future research should analyse qualitative data collected through focus groups/semi-structured interviews.

Studio Culture: A Heterarchically Structured Hidden Curriculum
In the 21st century of accelerated change, the hierarchical organisational values we have inherited from the procedural industrial revolution must be urgently questioned. With the influx of Generation Z learners entering higher education, the M&A pedagogy is no longer deemed relevant nor appropriate in engaging them. The design studio can take advantage of Generation Z’s preferred learning traits, favouring collaboration over a hierarchical and dispensational model of pedagogy (Schwieger & Ladwig, 2018; Rue, 2018), to create an alternative heterarchical studio pedagogical culture.

It takes two hands to clap. Tutors’ buy-in to teach in a non-hierarchical structure as facilitators, prompting and guiding students by mindfully inducing cross-pollinations in a team setting is essential. Through structured design briefs that help construct cross-pollinative conversations through interdependent bite-sized design exercises, beginning design students model behaviours and dialogues that encourage mindsets to normalise daily ‘setbacks’ of the ambiguous design process (Liow, 2021). It is vital to instil in first-year students the willingness to question their assumptions and participate actively in polemical discussions. It is observed that in the author’s first year’s design studio, the incubation period for the CTL mechanism to be running on ‘autopilot’ mode is approximately six instructional months.

As design education’s precarious tutoring force predominantly comprises adjunct practitioners (mostly from modest-sized practices), whose agendas and value systems are arguably biased toward developing ground-breaking formal expressions, their pedagogy inevitably favours stylistic outcomes through mimicry remain faithful to the ambiguous design process. An overly practice-orientated tutoring mindset (overly biased on achieving stylistic/pragmatic outcomes as ‘survival strategies’ in the violate market) will take precedence over tutors’ motivations for the advancement and reflections of pedagogical research and practice. The oppressive cultures of the M&A pedagogy, shaped by the Hidden Curriculum’s questionable habits, behaviours, and value systems, will continue to deeply permeate their professional practices and infuse them back into academia as design tutors in an endless cycle. The non-hierarchical CTL studio pedagogical culture seeks to turn the tide, one studio at a time.

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