The Ways That Architecture Students Experience Informal Learning between Peers within the Design Studio Learning Environment beyond Formal Timetable Activities

Understanding Undergraduate Students' Learning Experiences Via the Lens of Communities of Practice

Jierui Wang

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Welsh School of Architecture
Cardiff University

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ABSTRACT

This thesis refers to a study to investigate British architecture students' informal learning experiences between peers when students are outside formal timetables, to find out if the design studio learning environment had a significant impact on those learning experiences. The author initially conducted a small-scale interview with students from the Welsh School of Architecture, Cardiff University to collect students' learning experiences and stories when they were involved in physical and virtual environments respectively, to identify the significant effects of the design studio learning environment on those learning experiences of those students toward those two environments. Subsequently, using the theoretical lens of the community of practice, an investigation through observations, interviews, and focus groups was subsequently carried out, and more undergraduate architecture students at the Welsh School of Architecture were invited to explore their specific informal learning experiences in detail. Based on the theoretical lens of the community of practice, the findings discovered that the design studio learning environment is essential to almost all those students' informal learning. Therefore, even if these students studied outside their physical design studios, they still did their best to simulate a design studio learning environment to learn in the form of a small-scale learning group, a large-scale learning community, and/or a no-specific-scale learning guerilla. It was also discovered that there were some differences in the forms of informal learning between peers among 1st-, 2nd-, and 3rd-year students. Due to the characteristics of informal learning between architecture students within and outside physical design studios, this thesis summarises the corresponding modes of communities of practice, which are "homogenous community of practice", "dispersive community of practice", and "intermodal community of practice". These findings address the research question "What are architecture students' modes of informal learning experiences between peers within the design studio learning environment outside formal timetable and characteristics of such modes, via the lens of the community of practice" in details. Based on the findings, a model was generated to identify the specific mode of the community of practice constituted by those learning experiences. Future work should figure out the

ways that learning spaces are reformed to coordinate different communities of practice composed of architecture students' informal learning experiences between peers, as well as the specific architectural knowledge, skills, values, and attitudes that students developed from these communities of practice.

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CHAPTER ONE

Introduction

1.1 Introduction

Architecture is a practice-based discipline (Fleischmann 2019), wherein students are required to engage strongly with individuals within a specific physical learning environment, namely the design studio (Marshalsey and Sclater 2020). The strong engagements between individuals necessitate students to benchmark themselves against others, indicating that architecture learning in the design studio is somewhat based on peer-to-peer modes (Tafahomi 2021). Additionally, due to the nature of architectural education, informal learning situations are predominant (Pelman and Zoran 2023). Pelman and Zoran (2023) emphasised that, in informal learning, students can typically grasp their intuition and tacit knowledge of architectural design by engaging with complex and open-ended problems when they work on design projects. Accordingly, the physical design studio provides architecture students with a space to maintain informal learning with their peers.

Meanwhile, since the end of the twentieth century, higher education has focused on prompting students to be active learners, with communication, collaboration, and knowledge construction being key learning abilities (Marshalsey and Sclater 2020). Furthermore, educational spaces are required to accommodate specific devices and facilities, allowing for flexibility and optimal support for learners and their learning environment (Johnson 2018). Thus, higher educational institutions are currently endeavouring to build a learning community that facilitates learning, teaching, group work, presentations and assessments through digital or virtual portals (Marshalsey and Sclater 2020). In these roles, virtual learning environments, for instance, are perceived as significant venues which strengthen formal teaching and enrich students' lives, learning and work (Jesus et al. 2014). Since the introduction of virtual learning environments in tertiary education over the past decades, students have gained more alternative

approaches to support their academic learning (Boys 2011). In response, it has been found that many students in higher education have innovated novel learning methods and/or modes by integrating formal and informal learning, which are suitable for engaging in virtual environments to develop their own knowledge, skills, attitudes, and values without physical contact (Nistor et al. 2019-20). Regarding the application of the virtual learning environment in architectural education, there have been multiple attempts to introduce several virtual learning environments into the pedagogy to enhance inter-institutional collaborations and communications (such as Yeung et al. 1998, Yamacli and Tokman 2009, Ham and Schnabel 2011, Vosinakis and Koutsabasis 2013, Pektaş 2015, Schnabel and Ham 2013, Marshalsey and Sclater 2020, Iranmanesh and Onur 2021). Within the aforementioned examples, the virtual learning environments can accommodate and process virtual learning, communication, interaction and tutorials for the discipline of architecture, helping students communicate and study effectively, so that they can adapt to the contexts of virtual and blended learning.

To explore the available measures that enable architecture students to construct self-organised design studio learning environments where they can maintain informal learning between peers, some researchers attempted to introduce certain theories in architectural education to find out if students can study in informal environments, such as the "community of practice" (Morton 2012, Williams 2017), "client-situated practice" (Schermer 2013), "metaverse" (AbuKhousa et al. 2023), and "signature pedagogy" (Crowther 2013). However, the related studies mainly focused on students' learning experiences within the formal timetable, including desk crits, tutorials, and workshops, indicating that students' own learning experiences are influenced by the educational model and hierarchical relationships between the studio tutor and students. As indicated by Nistor et al. (2019-20): learning in formal situations is initiated, led, and supported by authoritative teachers, and this learning usually occurs within educational institutions, with explicit goals, curriculum, and certification; Comparatively, learning in informal situations is supported by peers and focused on everyday practice with flexible or

serendipitous outcomes. Hence, there is no specific aim and paradigm for empirical studies to research students' informal learning experiences especially when they are beyond their formal timetable activities. Even though, Williams (2017) indicated that students' learning experiences outside the formal timetables have positive effects on their design outcomes. However, the details of the ways that those effects happen were not explored in that study and relative ones.

Overall, it remains unknown whether the design studio learning environment can significantly affect architecture students' informal learning experiences between peers outside the formal timetable. Thus, it is valuable to identify the ways and factors through which architecture students experience such learning activities within the design studio learning environment.

1.2 Importance of the Design Studio Learning Environment to Architectural Education

Attoe and Mugerauer (1991) and Orr and Bloxham (2012) claimed that the design studio is the core educational place for design-related disciplines. Likewise, Marshalsey and Sclater (2020) articulated that design studio refers to a conventional and physical learning space for practice-based art and design education, providing students with a valid learning space to acquire knowledge in such diverse fields (Fleischmann 2019). Regarding the history of design studio and the teaching mode applied within it, it can be traced back to around the 19th century, since it was recognised that conventional classroom teaching was not successful in teaching design (Schön 1985), and the relative theories and practices have developed for over a century. Specifically, Schön (1983) explained the design studio teaching, stating that the design studio teacher, typically called "studio tutor", acts as a 'coach' or 'instructor' who helps students align with disciplinary norms and start to 'think like an architect'. Regarding the role of studio tutor, Alnusairat et al. (2020) indicated that the studio tutor guides students in peer learning, one-to-one interaction with tutors, the frequency of tutorials and feedback, and field trips and site visits. Thus, design students'

learning is guided by individual and ongoing feedback and is informed by a cycle of action and reflection (Fleischmann 2019). Additionally, McLaughlan and Lodge (2019) also indicated that the learning activity of design is a dynamic and iterative process. The process of design learning leads to various learning and even living experiences happened in the design studio, composing 'studio culture' (Koch et al. 2002). Schön (1983) pointed out that one of the typical learning activities in the design studio is the term "*reflection-in-action*", which describes the way architecture students' tacit actions when designing; and the notion "*reflection-on-action*", which describes the way students develop their design process and projects by repeatedly considering the merits and demerits of their previous actions before deciding how to move forward. Regarding the specific learning activities in the design studio, Johnson (2000) illustrated that they include the design brief and the desk crit, and Vosinakis and Koutsabasis (2013) added the interplay of design thinking and practice, and the design review. McClean and Hourigan (2013) articulated that all learning activities within the design studio are passive and akin to reflection-on-action. Notably, desk crit, also known as studio critique, has always been central to the education of design students (Shreeve 2011; Uluoglu 2000). This learning activity is deemed a catalyst to improve students' creative thinking and techniques (Fleischmann 2019), and interaction and self-evaluation (Park 2020), by comparing with others' work (Güler 2015), to further trigger individual creative development through a circle of action and reflection (Lee 2006; Schön 1987).

As a design-related discipline, architecture also employs design studio teaching to educate architecture students, regarding it as a signature pedagogy (Shulman 2005), which is called 'studio pedagogy' (Salama 2015). Within architectural education, 'studio' refers to the specific educational spaces and methods for architecture students (Crowther 2013). Compared with design studios in other design-related disciplines, the architectural design studio tends to assign more collective and comprehensive design projects, such as landscapes, buildings, public and private spaces, to students (Park 2020). Within the studio pedagogy, Kvan (2001) and Pektaş (2015) articulated that, students can experience

the design process within an optimal learning community, which helps evoke students' perception of being an architect. As one theory of the studio pedagogy, for example, Schön (1983) proposed the "reflective practice", which identifies that social interactions, active learning, and social engagement (Fleischmann 2019; Lee 2006) play a premium role in the process of architectural learning (Nicol and Macfarlane-Dick 2006), supporting students to benchmark themselves against peers (Koch et al. 2002). In other word, students are required to be engaged in multiple participative processes involving interaction with other individuals in the design studio (Nicol and Pilling 2000). Accordingly, since Schön's studies of design studio teaching in the 1980s, several specific teaching and learning activities for the studio pedagogy have been confirmed by some researchers (such as Schön 1987; Johnson 2000; Webster 2008), and these activities are classified into design brief, desk crit, design review, drawing, making models, sharing ideas with peers and tutors, working with people around, etc. Although some previous related literature discussed and explored specific examples and prospective engagements of learning activities between students and tutors within design studios, they were mostly based on the specific design projects and courses with preparation and all set-up facilities (Iranmanesh and Onur 2021).

It can be seen from the above that, within the design studio, related literature typically focused on formal learning activities (such as design brief, desk crit, design review) and informal learning activities under the supervision of the studio tutor (such as drawing, making models, sharing ideas with peers and tutors, working with people around). Therefore, within the design studio, there has been very limited focus on students' informal learning experiences between their peers without specific learning environments and studio tutors' supervisions and hierarchical relationships. To fill this gap, this thesis distinguishes the physical space of the design studio and learning environment within it as two separate terms. Specifically, the physical space of design studio is called "Physical Design Studios" in this thesis. This thesis regards context within physical design studios and all informal learning activities without studio tutors' supervision and hierarchical

relationships occurring within them as a collective concept, indicating the “Design Studio Learning Environment”. For example, within the design studio learning environment, students not only can work on their design studio module but also may collaborate on their technology module, and they may work in individual or on group work whatever they like. In addition, theoretically, a design studio learning environment can be constituted outside conventional physical design studios, such as a design studio learning environment constituted by students themselves in other spaces on campus, at home, or even in virtual environments. The next section presents related studies of informal learning within the design studio learning environment to explore the reason why researchers have limited focuses on informal learning outside formal timetable activities.

1.3 Informal Learning between Peers within Design Studios Learning Environment

Even though the theory and practice of design studio and studio pedagogy, composed by specific learning activities within the design studio, have been developed over several decades, design studio teaching is still not the perfect model for teaching architecture. For example, there are existing issues such as the hierarchical relationships between the tutor and students (Morton 2012), the loss of authenticity of practice (Webster 2005), passive learning (Núñez-Andrés et al. 2022), and the specific aim of educating students to become isolated architects rather than collaborative workers (Buchanan 2012). For instance, Yorgancioglu and Tunali (2020) concluded that conventional studio teaching makes the tutor acts as an expert or authority, leading students to behave and interact less within the design studio and tend to develop specialised tactics to fulfil the tutor’s preferences. Moreover, Tate and Osborne (2013), as cited in Güler (2015), claimed that the duration of interactions between the tutor and students is usually limited during the desk crit. These issues indicate that relying solely on formal teaching is insufficient to successfully educate architecture students. As stated by Roberts and Coombs (2023), the current architectural education, at least in UK, enables architecture students to not only regard

architectural profession as their only goal upon graduation but also to prepare for the challenges of the world.

These issues with design studio teaching, as stated by Chen and You (2010), have prompted the emergence of some alternative pedagogies in line with the (socio-)constructivist learning theory, enabling architecture students to grasp architectural knowledge in active rather than solely from professional studio tutors. It has been found by Webster (2008) that students who combine active and passive architectural learning seem to comprehend the discipline better. Likewise, Komarzyńska-Świeściak (2021) indicated that the architectural theoretical knowledge and practical skills are acquired through a student-centred learning process of creating a design project. Besides, some other previous related studies proposed that the studio pedagogy for architectural education should emphasise active learning between peers within the design studio (Salama 1995; Oh et al. 2013). Nevertheless, Gul and Afacan (2018) argued that the desk crit still remains a primary pedagogical procedure for design studio learning. This means that the tutor's pedagogical role shifts from an expert to a facilitator, and the students act as reflective practitioners actively engaged in design learning (Yorgancioglu and Tunali 2020). Hence, formally scheduled and small-scale meetings between students can frequently and casually coexist within the design studio (Chen et al. 1998). Even further, Burke (2015) claimed that, in the past decades, studio teaching has transformed into guiding students to cultivate their intuition and tacit knowledge, and Kampen (2019) added that studio teaching now can guide students to solve the problems originating from themselves.

It is noteworthy that the learning environment generated from the design studio ensures the nature of architectural learning between students, even though students were encouraged to learn actively without tutors' instructions. For example, Ioannou (2018) pointed out that the learning environment within the design studio can help students contact their peers in groups of two or three through their own methods; Garrison and Vaughan (2007) added that learning environments within the design studio is also helpful

in converting external information into intuition and tacit knowledge; Additionally, Bennet and Bennet (2008) indicated that these learning environments also assist students in finding the most effective methods to solve design problems collaboratively; Likewise, McClean and Hourigan (2013) also found that, fundamentally, the learning environment within the design studio is beneficial for facilitating students' peer interactions. Overall, as claimed by McLaughlan and Lodge (2019), to accomplish the design tasks, students are encouraged to acquire knowledge from a variety of sources, including building science and engineering, art theory and practice, art and architectural history, psychology, and philosophy and sociology.

Therefore, acquiring and co-constructing architectural knowledge from peers has been often regarded as part of the learning strategies and tactics in art and design disciplines where studio-based learning predominates in higher education (Budge et al. 2013), to supplement the students' insufficient expertise (Chiu 2010). It is recognised by Koch et al. (2002) that students regard peer learning as opportunities to discuss and improve their design thinking and practice, especially within the learning environment generated from the architectural design studio, as stated by Nicol and Macfarlane-Dick (2006) that architects do not work in isolation. Koch et al. (2002) indicated that interactions between students are usually served as opportunities to reinforce the inadequacies of student work rather than to build upon what is already adequate. Thus, as stated by Achten et al. (2011), learning activities happened between students rather than students and the tutor has become the prominent part of studio culture and occupy more of students' learning experiences within design studios. Some empirical literature has identified specific strategies for providing architecture students with paths to experience peer learning, as shown in Table 1.

Table 1 Different Comprehension of Peer Learning

Author	Categories	Explanation
Johnson et al. (2000)	Peer tutoring	Teaching which is facilitated by individuals who are not professional tutors (Topping, 1996), and this concept is originated from face-to-face learning environments (Wever et al. 2009).
	Peer assessment	The comments and feedbacks coming from non-profession individuals, is vital to the development of an individual's capacity for self-assessment (Nicol and Macfarlane-Dick 2006).
McClean and Hourigan (2013)	Peer dialogue	Students talk about specific questions between peers, has the capability of acquiring an equivalent status to tutor feedback, while dependents on trust and perceptions of quality.
	Peer discussion	The informal interactions conducted between peers, can provide students with reassurance for getting used to the environment of the design studio.

Nevertheless, as stated by Rodgers et al. (2001), architectural design is a knowledge-intensive activity, but architecture students' knowledge and experiences are less than those of tutors. Thus, students' peer learning is somehow affected by the power relationships between the tutor and students when studio tutors are present (Ioannou 2018), which are determined by different levels of knowledge and experience (Dutton 1991) and the limited time that tutors afford for individual students (McClean and Hourigan 2013). Due to these relationships, Dutton (1987) indicated that students might act in different roles facing different studio tutors. Yorgancioglu and Tunali (2020) even claimed that these relationships inform different pedagogical models such as the 'master-apprentice' model (Belluigi 2016), 'coach' model, 'reflective practitioner' model (Goldschmidt 2002) and 'critical friend' model (McDonnell 2016). Consequently, students' initiative to experience peer learning also differs in these models. For instance, Belluigi (2016) claimed that students find it challenging to make their voices heard in the master-apprentice model, since tutors act as the authority within that model; whereas Yorgancioglu and Tunali (2020) indicated that students are willing to express their design ideas and participate in the reflective practitioner model in which the tutor acts as a facilitator to inspire students' own design thinking and practice, encouraging students to develop as self-directed learners (Grow 1991; Gray 2013). Even so, students may realise that power relationships change over the duration of a design project (McClean and Hourigan 2013).

Due to studio tutors' hierarchical relationships between studio tutors and students, as well as the limited time and focuses on instructing students, as stated by Pelman and Zoran (2023), students' informal learning activities are dominant in architecture education. Regarding the informal learning, Neuman (2013) articulated that it encompasses a full spectrum of activities where knowledge sharing and study occur, which means that, as stated by Anggiani and Heryanto (2018), not only in formal learning spaces (classrooms, lecture halls, meeting rooms and other places based on teaching module and syllabus), students' learning activities can also be conducted informally. Thus, different from formal learning, Jamieson (2013) introduced that informal learning is a student-driven course or programme-based study that occurs outside formal learning spaces, or in them in out-of-class hours, without direct teacher involvement; Yaman et al. (2017) indicated that informal learning broadens educational performances, develops individual potentials, motivates towards self-directed learning, and sharpens students' intellectual ability and psychological development. Consequently, nowadays, as stated by Galanis, et al. (2016), to absorb knowledge efficiently and effectively, students need more support and resources to help them learn out-of-class and tutorial, so the percentage of arranging informal learning in the pedagogy is increasing in tertiary educational institutions. However, within the design studio and studio pedagogy, as stated by Dutton (1987), students are generally reluctant to openly share ideas informally in the presence of tutors, which may be caused by power relationships between students and studio tutors (Dutton 1991). Pelman and Zoran (2022) articulated that this phenomenon enables students to engage in informal learning outside the design studio and studio pedagogy, occurring within workshops, cafes, and private rooms, making difficult to trace informal learning processes in architectural education. Pelman and Zoran (2023) claimed that the difficulty of tracing informal learning in architectural education may lead to the lack of empirical research on the subject. This gap provides this thesis an opportunity to trace students' informal learning between peers within the design studio and other spaces where students create alike design studio learning environments.

Besides, it is also noticeable that, as stated by Noe et al. (2013), individual differences each have a significant relationship with informal learning. Rodgers et al. (2001) articulated that architectural design is a knowledge-intensive activity; however, Ioannou (2018) stated that students frequently lack sufficient knowledge and time to support their design practice and opinion sharing without the professional instructions of studio tutors. Therefore, theoretically, although some architecture students prefer to engage in informal learning without tutors' instructions, others cannot adapt to informal learning outside formal timetable activities.

It can be found from the above that, as stated by Ghassan and Bohemia (2015), even though informal learning activities between students themselves are dominant in architecture education, they still usually take place via peripheral instructions or guides from tutors, affected by various relationships between the tutor and students (Yorgancioglu and Tunali 2020). For example, Belluigi (2016) indicated that students receive feedback from the tutor throughout the process of a design project; Orr and Bloxham (2012) stated that the dialogue between the tutor and student enables the latter to realise and evaluate the potential and constraints of others' projects; Gray (2013) articulated that feedback from the tutor is shared among students as they express their opinions regarding others' design works. The specific explanations include:

1. McClean and Hourigan (2013) claimed that informal learning between peers requires more specificity, leading to variability in quality, thus being deemed less reliable than tutor input.
2. Ioannou (2018) argued that, as students regard informal learning between peers as an interaction based on the relative merits of design proposals without focusing on particular outcomes, it leads to a low quality of output that cannot reach the standard of that with professional instructions.

Accordingly, within the design studio learning environment, empirical studies have found that informal learning between peers generally enables architecture students to cultivate tacit knowledge, intuition, and individual and collaborative skills beyond the formal

instructions of studio tutors; this learning method also somehow avoids the hierarchical relationships between the studio tutor and students, enabling students to openly express their design ideas. However, Yorgancioglu and Tunali (2020) and Ungaretti et al. (2009) all claimed that informal learning still has not been regarded as a predominant pedagogy for design studio education. Thus, the specific experiences of this learning method lack focus in empirical studies, so this thesis aims to unfold the details. Specifically, this thesis defines such "informal learning" as any learning or even non-study related activities happened outside students' formal timetable without studio tutors' supervisions, such as talking about design ideas regarding design projects, sharing learning resources about portfolio and some architects' projects, walking around to check others' design progress, working hard together, cooperating to accomplish architectural technology tasks, etc. Thus, these informal learning activities are not only inclusive part of a design studio module. Instead, they also include students' collaborating on their technology module. In addition, these informal learning activities can occur in any spaces, including physical design studios and other spaces outside them, such as non-timetabled learning spaces on campus and student accommodations, as well as private rooms.

1.4 Impact of COVID-19 on Architectural Education

During 2020 to 2022, some force majeure disrupted the learning environment within physical design studios, forcing students to experience informal learning outside formal timetable activities and beyond physical design studios and studio pedagogy. Specifically, since the beginning of 2020, the COVID-19 pandemic has caused nearly 1.6 billion learners (Pokhrel and Chhetri 2021) to work from home due to university closures worldwide (UNESCO 2020). Iranmanesh and Onur (2021) indicated that this phenomenon also occurred in architectural education. During the pandemic, Komarzyńska-Świeściak et al. (2021) articulated that architecture students were forced to study remotely within their own homes, indicating that they lost the physical design studio to maintain face-to-face interactions with the studio tutor and other students, so they had almost no opportunities to meet their peers physically in such a condition. This special

period provided this thesis with an opportunity to research architecture students' informal learning between peers when they were outside physical design studios.

However, in the meanwhile, Ceylan et al. (2021) argued that many architectural schools had yet to gain the experience to organise tutorials and desk crits for all students when physical design studios were suddenly converted from a physical to a virtual environment. Therefore, these students somehow had a tough time overcoming such issues. For example, Ceylan et al. (2021) claimed that time was wasted due to teaching how to use the online platform during the first few weeks of the pandemic. In addition, Alnusairat et al. (2020) also argued that the management of workload and time, the efficiency of communication, and any other additional workload all increased due to the rapid shift to online learning. Anyway, Salama and Burton (2022) indicated that another main challenge of COVID-19 to architectural education was the sudden shift and the intensity of virtuality that most architectural institutions were not prepared for, in addition to the scale and level of urgency required. To avoid the emergency such as the early stage of the pandemic in the future, this thesis took this opportunity to identify if the physical space within design studios and the design studio learning environment have impacts on students' informal learning between peers outside formal timetable activities.

In addition to the sudden loss of physical environment within physical design studios, it is also noteworthy that, as stated by Aucejo et al. (2020), the "work from home" policy brought some conveniences to architecture students' informal learning, enabling them to more freely arrange their own time to do the things they like, as their study time generally decreased. Thus, this policy motivated this thesis to study architecture students' informal learning modes without the guidance, instructions, and hierarchical relationships pf studio tutors.

Despite the issues caused by "work from home", Daniel (2020) claimed that the pandemic promoted the trend of transforming physical learning environments into virtual ones. Although, as stated by Kvan (2001), virtual learning environments and relative technologies have not been a new trend in architectural education, Fleischmann (2021)

claimed that they have not been fully explored to adapt to the majority of architectural institutions, which led to the chaos of architectural education worldwide at the beginning of the pandemic. Thus, to prevent any other unpredictable challenges or issues caused by the urgent transition of design studio learning environments, just like at the beginning of the pandemic, architectural education is required to develop the educational form in more alternative ways. Nevertheless, the virtual practices ultimately brought innovative measures to architectural education during the later stage of the pandemic. For instance, Nespoli et al. (2021) pointed out that virtual learning environments and relative communication technologies provided architectural pedagogies with additional support for learning, course content and management, assessment tools, collaborative whiteboards, and design environments. Anyway, regarding potential applications of virtual learning environments and its relative technologies, the revolution of architectural education into the virtual world is valuable to be explored further to avoid the chaos of the sudden swift of learning environments and to discover more values in architectural education just like during the pandemic.

Accordingly, this thesis not only explored architecture students' informal learning activities between peers within the design studio learning environments in physical design studios but also discovered those experiences in other spaces, including virtual environments. The aim of exploring these informal learning activities in different spaces is aiming to know what aspects were missing when engaging in these learning activities without the design studio learning environment of physical design studios. The following sections state the main aim and research question that need to be focus on to set a clear research plan and methodology framework for collecting relevant data and making further conclusions.

1.5 Aim and Research Question

In light of the research background and contexts, the nature of architectural education and the COVID-19 pandemic both provided this thesis a significant opportunity to discover what specific aspects that architecture students experience informal learning within the

learning environment whatever within physical design studios or outside them, by analysing students' learning experiences outside their formal timetable activities and even in off-campus places. In other words, this thesis aims to unfold the modes and characteristics of those learning experiences in any conditions, even though the physical spaces and face-to-face working modes were all taken away. To have a clear understanding of architecture students' informal learning experiences between peers outside their formal timetable activities, this thesis applied the theory of "community of practice" as a lens to research the question. Based on this condition, the "design studio learning environment" refers to a community of practice in this thesis, indicating that outside formal timetable courses, sessions, tutorials, and desk crits, students can engage in their learning and other tasks at a random place, emerge in the working environment where others work hard, or casually walk around to check others' working progress and design ideas, etc., as the form of in individual and group work within this design studio learning environment.

The outcome of this thesis will ultimately contribute to architectural pedagogy, architectural learning models, and physical and virtual architectural learning environments, making architectural learning environments more conducive to architecture students' informal learning between peers within physical design studios. Apart from its contribution to architectural pedagogy, the findings of this thesis can also potentially innovate a blended learning system, which is the combination of physical and virtual learning (Achten et al. 2011, Oliver 2018), for future design-related disciplines. Figure 1 reveals the research field of this thesis.

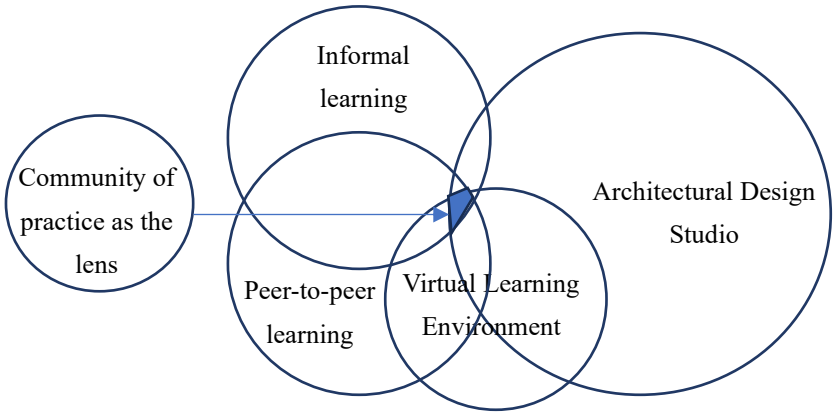

Figure 1 The Relationships between the Research Field and the Discipline of Architecture

To achieve the aim and purposes above, the main research question "What are architecture students' modes of informal learning experiences between peers within the design studio learning environment outside formal timetable and characteristics of such modes, via the lens of the community of practice" needs to be answered, followed with objectives to look for detailed answers below:

1. To identify if the design studio learning environment impacts on architecture students' informal learning.
2. To classify these modes of informal learning and to identify what characteristics they have.
3. To identify the ways that communities of practice develop throughout different academic years.
4. To generate a model of these modes using the theoretical lens of community of practice.

As for the rationale to introduce the community of practice as the lens to address the second objective, the next section introduces specific reasons.

1.6 "Community of Practice" as A Lens to the Research Field

Regarding the community of practice, Wenger et al. (2002) articulated that it refers to the group of people who share a concern, a set of problems, or a passion for a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis. Likewise, Elarji and Michels (2021) described that the community of practice as a group

of people who participate in a learning process peripherally and are then influenced by the culture of and settings of the group. In addition, Ding and Ng (2010) articulated that communities of practice are informally constituted by people who pursue shared enterprises over time. Wenger (1998) argued that a community of practice enters into the experience of participants through their strong engagement, resulting in three basic characteristics: a shared repertoire, mutual engagement, and a joint enterprise. The statements above imply that to foster a community of practice, people are encouraged to learn collectively and actively from others with mutual problems or concerns (Zamberlan and Wilson 2015) towards a stated goal (Adam et al. 2011). Accordingly, to constitute a successful community of practice, different core roles within the community of practice should be performed well by the participants, including community leaders, facilitators, subject-matter experts, core members, and "lurkers" (Baker and Beames 2016). Thus, due to the nature of architectural education and learning activities within design studio pedagogy, the theory of the community of practice can be regarded as a lens to research architecture students' informal learning within physical design studios and other spaces where students organise alike design studio learning environments outside their formal timetable activities. Empirical applications of the community of practice into architectural education are stated in the next paragraph.

Taking the concept of the community of practice as a lens has brought some practical contributions to architectural education and studio pedagogy in some empirical studies. For example, Schermer (2001) applied the perspective of the community of practice to identify that the client-situated practice can be used to educate architects who not only acquire architectural knowledge and skills but also social and cultural expertise. Faulconbridge (2010) indicated that architects' learning and innovation could be facilitated by means of local design studios and communities of practice, and nonhumans (such as models, texts, and photographs) are vital to constitute such communities of practice. Williams (2017) articulated that the design studio learning environment has the capacity to bring students with shared meanings, goals and responsibilities, and the self-

organised community of practice encourage individual student's learning. Besides, Morton (2012) indicated that, even outside of class, students usually engage in informal groupings based on country of origin and friendships to develop their learning process. In addition, Yates et al. (2022) presented an examination of an architectural programme to change the educational mode of architecture and other related disciplines, enabling different groups of individuals to share thinking and knowledge in the form of communities of practice. These examples all demonstrated that the community of practice mode can be applied in architectural education to facilitate the sharing of architectural knowledge and informal learning between students.

Among these theories, the community of practice was selected as the lens to answer the research question in this thesis. Main reasons of choosing this theory as the lens include:

1. It is firstly necessary to regard the design studio learning environment and architecture students' informal learning experiences within it as an entire subject (Daniel 2020, Iranmanesh and Onur 2021);
2. Architectural education is based on setting a specific design project (Iranmanesh and Onur 2021), and students need to figure it out through problem-solving abilities (Hettithanthri and Hansen 2022);
3. This thesis focuses on architecture students' informal learning experiences, and the theory of the community of practice is applied to informal situations (Ding and Ng 2010);
4. Studio education require students to collaborate and share knowledge between different individuals (Fleischmann 2019);
5. The theory of the community of practice has been used in some previous studies on researching students' collaborative learning and knowledge sharing in virtual environments (such as Dougherty and Parfitt 2013, Mavri et al. 2021), so it can be applied to this thesis when the virtual learning environment was suddenly introduced to architectural education during the pandemic period.

In light of previous literature, there has been a superficial understanding of regarding the community of practice as a lens to research the relationships between architecture students' learning and physical design studios. For example, it was found by Morton (2012) and Willaims (2017) that architecture students normally self-organised learning groups to study more knowledge beyond formal timetable activities, such as tutorials and desk crits. Nevertheless, there have yet to be any empirical findings on the specific ways and modes that architecture students experienced informal learning with their peers within the design studio learning environment when they are outside their formal timetable activities or even outside physical design studios, because Williams (2017) articulated that those experiences are hard to be observed and evaluated by the studio tutor. In addition, Cuff (1991) argued that most architectural schools might not be thoroughly preparing students with the skills needed for communities of practice, such as lacking systematic development or assessment of communication and interpersonal skills for sharing and developing students' ideas with each other (Cuff 1991), and existing hierarchical patterns of interactions between the studio tutor and students (Morton 2012). Besides taking the lens of the community of practice to research learning in physical environments, Deakin et al. (2011) pointed out that some earlier studies (such as Ellis et al. 2004, Johnson 2001) concentrated on exploring the ways in which the knowledge dynamics of virtual learning environments differ from the community of practice that is dependent on social familiarity and direct engagement to sustain their mutual relationships. Worse, as virtual environments was suddenly introduced into architectural education due to impacts of the COVID-19 pandemic, Iranmanesh and Onur (2021) argued that learning methods and activities were forced to become more innovative, diverse, but unfamiliar to architecture students during the early period of the pandemic. This thesis investigates the extent to which architecture students' informal learning experiences between peers apply to the physical design studio and to such learning experiences that might occur within the virtual environment.

1.7 Methodology Framework

To answer the research question and address the objectives, the data collection methods are all designed to gain insight into architecture students' daily experiences and activities of informal learning between peers in physical design studios, other places, remote ways, and even virtual environments outside students' formal timetable activities. Undergraduate architecture students at the Welsh School of Architecture, Cardiff University are selected as the samples. Regarding the reason for taking students in this school as the sample, it is not only because it is an international school where a large number of domestic and overseas students can study, but also because the majority of these students live in local houses and student accommodations without the companionship of their parents as they come from different parts of the UK.

Since it is unknown what these students really encountered and cared about in their learning experiences without formal instructions and hierarchical relationships from studio tutors, the study process of this thesis was divided into two separate phases, from semi-structured to ethnographic, to check all the questions are precise and remove invalid ones (Gillham 2007). Specifically, the first-phase study was generally aimed to know what aspects of some architecture students' informal learning between peers were missed when the design studio learning environment of physical design studios was taken during the "work from home" period of COVID-19 pandemic. In addition, the first-phase study summarised general characteristics of such informal learning. Since these characteristics were found, furthermore, the theory of the community of practice was found that it could be introduced to be the theoretical framework of this thesis after the first-phase study. Thus, after the time of "work from home", the second-phase study investigated architecture students' informal learning between peers within the design studio learning environment within and outside physical design studios, via the lens of the community of practice. Both phases took qualitative approaches to collect data, and the specific steps and methods of data collection are stated below.

To address the research question “What are architecture students’ modes of informal learning experiences between peers within the design studio learning environment outside formal timetable and characteristics of such modes, via the lens of the community of practice”, the first phase of the study aims to detect what architecture students normally encountered when they study outside formal timetable activities within the design studio learning environment and beyond it during the period of “work from home” in the COVID-19 pandemic. In addition, to address the first objective “to identify if the design studio learning environment impacts on architecture students’ informal learning”, the first phase of study also aims to identify if the design studio learning environment affects students’ actions on informal learning in different spaces. Therefore, during the first phase, a few students were invited for interviews online, comparing and assessing their informal learning experiences within the learning environments of physical design studios and other spaces outside them, including students’ physical design studios, non-timetabled spaces on and off campus, and virtual learning environments. Specifically, the first phase consists of interviews (n=9), conducted by asking semi-structured and open-ended questions, at the initial stage of the pandemic. The interviews were conducted at the Welsh School of Architecture, Cardiff University. The first phase of the study found that the responses of these participants indicated similar perspectives on experiencing informal learning between peers within traditional design studios and other spaces, specifically virtual environments.

Subsequently, the second phase of the study focused on more students’ informal learning experiences between peers at the Welsh School of Architecture, Cardiff University. Since the significance of the design studio learning environment for architecture students’ learning outside formal timetable activities was detected in the first phase of the study, the second phase particularly focused on thematic characteristics and modes of students' informal learning experiences between peers both within and outside physical design studios beyond formal timetable activities. Thus, these findings from the second phase of the study address the second objective “to classify these modes of informal learning and

to identify what characteristics they have". Related data were collected through ethnographic methods, including observations, focus groups, and interviews. Specifically, the initial data were collected through observations to record the daily routines of study participants' informal learning experiences in different spaces. The focus points of the observations included the study place, study members, the number of study members, study time, the duration of the study process, and the specific learning activities. Furthermore, through focus groups and interviews, study participants elicited their prevalent informal learning experiences and the specific ways in which such experiences helped their own architectural learning and thinking. Therefore, questions designed for focus groups and interviews involved asking students about their perceptions of the specific reasons for engaging in different informal learning activities within such learning environments. In addition, the basic information of the interviewees and their study places, including their nationalities, genders, academic years, and preferences for the study place, was also collected to support the data. Ultimately, the collected data were classified into specific themes according to three attributes of the community of practice, which are a shared repertoire, mutual engagement, and a joint enterprise. Subsequently, characteristics of these three attributes were set as sub-themes to match data collected from observations as well as interviews and focus groups, respectively. For example, characteristics of mutual engagement include engaged diversity, doing things together, relationships, social complexity, community, and maintenance. Furthermore, to build the connection between these characteristics and data collected from this study, these sub-themes were interpreted based on the modes and characteristics of participants' informal learning experiences between peers, and they were further matched with specific data. These collected data were coded into specific themes according to the distinctive modes and common characteristics of such informal learning activities between peers across three academic years. Consequently, the final themes were summarised from these specific themes.

Besides these common characteristics, it was also found that some general modes of these informal learning were usually generated by students in specific academic years, manifesting distinct characteristics as well. Consequently, according to these themes, these communities of practice were classified by the participants' academic years, addressing the third objective "to identify the ways that the community of practice develop throughout different academic years".

Since the collected data were interpreted into specific themes, thematic analysis was selected as the data analysis technique for both phases of the study to interpret the broad opinions and experiences of informal learning of the study participants into specifically organised themes (Barbour 2007). As explained by Clarke and Braun (2017), thematic analysis can be used to identify patterns within and across data in relation to participants' lived experience, views and perspectives, and behaviour and practices. Therefore, to analyse data in this thesis, specifically, various informal learning experiences from different individuals were distinguished into specific themes by classifying such experiences into thematic categories, which are interpreted from three attributes of the community of practice, including mutual engagement, a joint enterprise, a shared repertoire.

To achieve data collection and analysis methods, it is crucial to identify the appropriate methods to collect the data on students' experiences of informal learning between peers within the physical design studio and other spaces, including virtual environments. Afterwords, data collected from students' oral and written responses need to be interpreted the into versions that can be coded and analysed. Students' responses should be identified as specific themes so that they are suitable for analysis.

1.8 Structure of This Thesis

This is the outline of the structure of the thesis: explaining how each chapter contributes to the argument of this study. This thesis is structured around eight chapters as follows:

1. Chapter 1 introduces the research background, significances, and the research question.

2. Chapter 2 reviews the previous literature related to the informal learning between peers and its application in the community of practice, and also reviews the previous literature related to design studio education and its relationships with the community of practice, to identify and explore the research foundation and gaps.
3. Chapter 3 presents the collected data from the study in the first phase and the measures for analysing the data. The research methods applied in the first phase are derived from those in previous related studies. The study findings illustrate the informal learning activities occur between peers and are allocated by students themselves within different learning environment, identifying general characteristics of such learning experiences and the significance of the design studio learning environment to them in specific academic years. Consequently, the findings of the first phase of the study address the first objective "to identify if the design studio learning environment impacts on architecture students' informal learning". Additionally, the findings also point out a prototype model of the modes of informal learning between peers using the theoretical lens of community of practice.
4. Chapter 4 establishes the methodology framework in this study, elaborating on the methods and process of the second phases of the study, which refers to the main study. The second phase is based on research methods and findings from the first one, to address the research question furthermore.
5. Chapter 5 elaborates on the thematic characteristics of architecture students experiencing informal learning between peers outside formal timetable activities, conducting a theoretical analysis throughout three academic years. These characteristics are classified according to three attributes of communities of practice, which are a shared repertoire, mutual engagement, and a joint enterprise. Therefore, the findings of this chapter address the second objective "to classify these modes of informal learning and to identify what characteristics they have".

6. Chapter 6 presents the common characteristics of students' informal learning activities between peers by students in different academic years, analysing the development of communities of practice constituted by such learning activities throughout the three academic years. Consequently, the findings of this chapter address the third objective “to identify the ways that the community of practice develop throughout different academic years”.
7. Chapter 7 summarises the model of communities of practice modes which are constituted by architecture students’ informal learning between peers. This chapter ultimately classifies three main modes of communities of practice constituted by such informal learning activities. Additionally, this chapter addresses the last objective “to generate a model of these modes using the theoretical lens of community of practice”.
8. Chapter 8 conducts a discussion between the findings from this thesis and other previous studies, via the lens of the community of practice.
9. Chapter 9 concludes the contribution of this thesis to the research field and indicates the limitations of this thesis and the gaps to be filled in future studies.

CHAPTER TWO

The Informal Learning between Peers within The Architectural Design Studio and How It Connected to the Community of Practice

2.1 Introduction

As stated in the aim and research question in Section One, the primary goal is to clarify the basic conception and theory of informal learning between peers and to determine the ways in which it connects to the community of practice. This chapter reviews previous research on informal learning between peers and outside formal pedagogies, and further explores the relationship between such learning and the community of practice to identify the research gap.

Furthermore, since it was discovered that a research gap exists between informal learning between peers and the community of practice, it is still unknow how this gap relates to architectural education. Therefore, this chapter presents the concept and characteristics of design studio education and its relationship with the community of practice.

2.2 The Relationship between Community of Practice and Informal Learning

2.2.1 Informal Learning between Peers and outside Formal Pedagogies

To gain a clear understanding of the informal learning between peers, it is necessary to initially define and characterise the term of "*learning"*. Williams (2017) argued that, in general assumption, learning is a process of dissemination where knowledge is transmitted from teachers to learners, and where learning is primarily about acquiring information that can be drawn upon for practice. Comparatively, "learning" in this study, as stated by Gross and Naish (2015), is more likely to be comprehended as the process of acquiring reformed understanding, knowledge, behaviours, skills, values, attitudes, and preferences, which means that learners acquire information and practices simultaneously

when they are fully engaged in learning (Lave and Wenger 1991). Similarly, Kampen (2019) cited Kolb and Kolb (2005) that learning is facilitated by a process that draws out students' beliefs and ideas about a topic from the outside world for examination, testing, and integration with new and more refined ideas, so as to adapt to the world. Schacter et al. (2016) indicated that much of these processes represent that the accumulation of skill and knowledge comes from repeated experiences, which probably occurs among higher-education students. Accordingly, the learning process describes above is critical and iterative, involving gaining knowledge from the outside world and generating novel knowledge and experience based on learners' own perspectives, which are diverse and not strictly bound by specific patterns. In addition, it is noticeable from So et al. (2010) that learners acquire knowledge not only from abstract sources, such as environments, experiences, customs, and cultures, but they also learn from physical stuff, especially parents, siblings, teachers, friends, etc. Thus, peers can be regarded as one of the knowledge sources.

Marques et al. (2013) indicated that there have been abundant informal learning theories in empirical studies in the past few decades. Nevertheless, my thesis adopts the perspective from Lai et al. (2013), indicating that informal learning represents that learners have more control and freedom to choose what to learn and how learning is evaluated, which means that learners' learning activities are organised based on their own initiatives. Specifically within higher education, Jamieson (2013) argued that informal learning is a student-driven course or programme-based study that occurs outside formal learning activities, or during out-of-class hours, without direct teacher involvement; Neuman (2013) claimed that informal learning encompasses a full spectrum of activities where knowledge sharing and study take place, which means that informal learning has the capacity to replace the formal learning when learners are learning entirely on their own. Yaman et al. (2017) supplied that informal learning broadens educational performances, develops individual potentials, motivates self-directed learning, and sharpens students' intellectual ability and psychological development. However, Coffield

(2000) indicated that most learning research typically needs to pay more attention to the significance and implications of informal learning. Thereby, exhaustive and specific informal learning experiences between students are still ambiguous in some subjects.

Regarding informal learning between peers, it is first necessary to understand the learning activities between peers, or the term "peer learning", and there is a long history of the theory (since 1980s), and its application has also changed throughout the history (Topping 2005). Generally, "*peer*" refers to a learner in the same cohort or learning situation (Boud and Lee 2005; Riese et al. 2012), which can be regarded as students, teachers, and even schools (Miquel and Duran 2017). Specifically, this study defines students as the "peers". Boud et al. (2001) contended that peer learning can be regarded as small-group activities where individuals of equal status actively help each other formally and informally, and Topping (2005) added that matched companions helping each other also be considered peer learning. Boud et al. (1999) indicated that peer learning can expand learners' understanding of course contents, help learners cultivate a sense of collaboration, and make them to be responsible for their learning, etc. Johnson et al. (2017), as cited in Riese et al. (2012), indicated that peer learning practices are promoted for current educational systems at all levels, because Boud et al. (2001) claimed that these practices bring positive effects on students' achievements, teaching staff's workload, and students' collective working abilities for their future employment. For example, Wong et al. (2003) proposed that students' peer learning with a more knowledgeable individual can lead to significant progress, and McClean and Hourigan (2013) claimed that such progress can generally be achieved through discussing shared difficulties, understanding relative levels of progress, and fostering a spirit of mutual support. In addition, McClean and Hourigan (2013) argued that common aptitudes and attitudes typically generate students' peer learning activities, and peer groups can be united through common interest, facilitating the exchange of ideas and concepts, and motivating deeper learning through sharing materials, references, and perspectives. Thus, peer learning generally occurs between friends or individuals with mutual traits. Meanwhile, peer learning is also served to moderate the sense of conflict

(Anthony 1991) that can arise due to the subjectivity and the variety of perspectives of different individuals.

Like peer learning, each learner's differences are significantly related to informal learning (Noe et al. 2013), such as different characteristics, habitus, and customs. Thus, there are various forms of informal learning based on different individuals' learning characteristics. For example, Schugurensky (2000) proposed three forms of informal learning: self-directed learning, incidental learning, and socialisation. The criteria are determined by learners' intentionality and consciousness. Specifically, self-directed learning contains the highest level of learners' intentionality and consciousness, incidental learning requires consciousness but no intentionality, and there is no intentionality or consciousness in socialisation. Likewise, Eraut (2000) classified informal learning into three types based on different 'level of intention': implicit learning, reactive learning, and deliberative learning. Regardless of the type of informal learning adopted, each learner typically absorbs knowledge from two specific contexts: individual and interactive learning environments. In this thesis, the interactive learning environment explicitly represents the learning activities between students (peers). Nowadays, as stated by Chang-Tik and N. Goh (2020), to absorb knowledge efficiently and effectively, and due to increasing conflicts between students and teachers, students need more supports and resources to help them learn out-of-class and outside -tutorial, so the percentage of engaging in informal learning in the pedagogy is increasing in tertiary educational institutions (Marques et al. 2013). Therefore, by engaging in informal learning with peer learning, learners will grasp more detailed approaches to absorbing knowledge collaboratively with high efficiency, without the restrictions and hierarchical relationships generated by teachers or tutors. However, Hakkinen and Hamalainen (2012) claimed that empirical research lacks relevant studies on specific experiences of these informal learning activities in higher education.

Therefore, informal learning is valuable to be combined with peer learning for further research on students' learning experiences when they are outside formal education, so as

to design pedagogy more specifically to enhance informal learning between peers. Specifically, this study focuses on students' informal learning between peers in architectural education, particularly in the design studio learning environment. Nevertheless, Springer et al. (1999) indicated that there is still a need to have more investigations into the specific learners' experiences of peer learning and to explore its potential application in architectural education. To fill this gap, this thesis explores students' experiences of informal learning between peers outside the formal timetable activities of architectural pedagogy, such as the instruction of studio tutors and the hierarchical relationships caused by it (Morton 2012).

2.2.2 The Community of Practice and Informal Learning between Peers

Communities of practice, as introduced by Wenger et al. (2002), are groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis. Specifically, Wenger (1998) indicated that a community of practice enters the experience of participants through their strong engagement, resulting in the three essential attributes: a shared repertoire, mutual engagement, and a joint enterprise.

Wenger (1998) articulated that a shared repertoire refers to communal resources that community members have developed over time, containing mutual stories, styles, tools, actions, historical events, concepts, etc. Mutual engagement, based on Wenger's (1998) statement, refers to the relationships that bind community members as a unity, including characteristics of engaged diversity, doing things together, social complexity, community, maintenance, etc. A joint enterprise, according to Wenger's (1998) theory, results from a collective negotiation process that reflects the full complexity of mutual engagement, including characteristics of negotiated enterprise, mutual accountability, interpretation, rhythms, etc. Wenger (1998) emphasised that communities of practice naturally develop when new members, technological developments, and the adoption of new knowledge build on shared repertoires. This creates a dynamic learning environment that can scale to meet the learning needs of the community.

The proactive, systematic, and strategic development of the community of practice, as stated by Wenger et al. (2002), can increase the learning potential of that community. Therefore, Tummons (2014) emphasised that when we describe some learning activities as the community of practice, we also need to define the specific details of a shared repertoire, mutual engagement, and a joint enterprise of those activities in the community of practice, so that we can satisfactorily state what the practice of the community actually is.

As the community of practice is involved in higher education, a conflict has existed between pedagogy and the characteristics of the community of practice, which are a shared repertoire, mutual engagement, and a joint enterprise. Thus, Wenger (1998) proposed a broader concept of the community of practice, which is 'learning architecture'. This theory emphasises designing an assemblage of components or resources to allow learning to take place. Tummons (2014) argued that these components and resources consist of a place, tools and equipment, people, and activities, all designed to create a context where learning can happen. However, Tummons (2014) emphasised that even with the most rigorous and comprehensive learning architecture, it still needs to be determined what to learn, how to learn, and when to learn. Thus, Li et al. (2009) indicated that Wenger and other researchers generally describe the community of practice as an informal learning organisation.

However, without the proactive, systematic, and strategic development of the community of practice, it is unknown which specific factors influence the learning potential of that community, such as informal learning between peers. The next section discusses the specific research on informal learning activities between peers in architectural education and the application of the community of practice lens.

2.3 The Relationship between Community of Practice and Design Studio Education

2.3.1 The Community of Practice and Informal Learning between Peers Engaged in Physical Design Studios

Sagun et al. (2001), as cited in Alnusairat et al. (2021), argued that it has long been recognised that the environment within the physical design studio differs from that within the traditional classroom. As stated by Schön (1987), in traditional viewpoints, a physical design studio is considered as a space where fixed programmes occur between students and studio instructors, consisting of four aspects: (1) a culture where students and lecturers collaborate, (2) a physical fixed space where teaching and learning can take place, (3) a method of teaching and learning, and (4) a programme of activity. Some other studies provided their understanding of physical design studios. For instance, Dutton (1987) regarded the physical design studio as the environment students are socially and intellectually engaged in various sets of activities, such as model-making and drawing, while shifting between analytic, synthetic, and evaluative models of thinking. Koch et al. (2002) regarded the physical design studio as the environment where the learning and non-study related experiences of studio tutors and students constitute the unique "studio culture". Lueth (2008) regarded the physical design studio as the place where students were engaged in a complex social context and they were encouraged to collaborate with their peers, even beyond their formal timetable activities, without the hierarchical relationships between their studio tutors. Williams (2017) demonstrated that the physical design studio represented a place of possibilities, of doing valuable things and making sense of these things with peers. In addition, Ceylan et al. (2021) regarded the physical design studio as the environment where students learn diverse ways of design and cultivate their creativity through experience and learning by doing. Accordingly, most previous studies regarded the physical design studio as the environment where

architecture students engage in their learning activities. My thesis, furthermore, regards the environment of physical design studios as the “design studio learning environment”. Ding and Ng (2010) argued that the theory of the community of practice has been introduced into architectural education due to the complexity of design studio learning environment and architectural knowledge, aiming to encourage students’ collaborations and knowledge sharing between different individuals by all possible ways. Specifically, Tunçer and Sariyildiz (2010) indicated that the community of practice in architectural learning could be regarded as architecture learners working together toward a common goal, which requires a shared and specific language for community members. In accordance with that theory, Williams (2017) articulated that the design studio learning environment has the capacity to bring students with shared meanings, goals, and responsibilities, and the self-organised community of practice encourage individual students’ learning. Besides, Morton (2012) indicated that, even outside of class, students typically engage in informal groupings based on country of origin and friendships to develop their learning process. Zamberlan and Wilson (2015) indicated that the context in which students learn from peers can help foster the community of practice, as it is characterised by collective and active participation of peers towards a stated goal (Adam et al. 2011). Nevertheless, as stated by Tummons (2014), learning is emergent, fluid, and challenging to predict or control via the lens of communities of practice. Many previous authors have introduced a student-centred learning model to bring more energy and passion to architecture students’ active learning without the institutions and hierarchies of studio tutors, as shown in Table 2.

Table 2 Examples of Informal Learning between Peers within Design Studios

Author	Project	Contents	Findings
Mewburn (2012)	A design studio teaching paradigm which indicates that a design studio facilitator called Peter Corrigan in RMIT	Corrigan's does not teach students how to think like an architect; instead, he plays a part in manufacturing experiences designed to provoke the visceral subjectivity of the struggling architectural students in their own practice.	Although studio tutors, acting as the role of choreographer, still in presence, they are never going to be entirely in control of any performance in the process of studio education.
Ungaretti et al. (2009)	To have a broader perspective of potentials of the peer learning between students from different disciplines in physical design studios	Students from the disciplines of marketing, environmental design and graphic design were bought together to work in cross-disciplinary teams to solve an industry-specified design problem.	This format exploited peer learning to bring students who were unfamiliar with design thinking up to speed more rapidly. Students with different disciplinary understandings can contribute their discipline specific knowledge, language and ways of working to a specific design problem, and students are enabled to identify the strengths and limitations of their own disciplinary knowledge.
Ghassan and Bohemia (2015)	A cooperatively international design studio called "Global Studio" based on peer tutoring pedagogy		Although some students feel that they have very different and special learning experiences which can help them get more knowledge, others still feel lacking professional instructions and accompany from tutors when to support their learning
Vowles et al. (2012)			Learning activities within design studios often occurred between undergraduate students; while postgraduate students appear to be less dependent on studio for learning, as they have enough knowledge and skills learnt from the design studio learning environment
Kampen (2019)			Design studio education is aiming to foster students' intuitive responses and tacit knowledge, which both are not recognised by the majority of beginning design students

For example, Zamberlan and Wilson (2015) recognised that the expectation of high performance in students' learning practices requires the cooperation between professional instructions and a strong community of practice framework. To achieve a successful community of practice, Baker and Beames (2016) emphasised that it is crucial for the studio instructor and students ought to act in appropriate core roles. Thus, in addition to community leaders, facilitators, and subject-matter experts who pursue and facilitate the formal activities and discussions of the community of practice (Wenger et al. 2002), it is also essential for some individuals to act as core members and lurkers to engage in

informal meetings and gain value from the community of practice peripherally. Baker and Beames (2016) indicated that, as the core roles act as their duties, learning appears to be grounded in shared and practical repertoires where the organisation of teaching, space and facilities are student-centred, and where the tutor's role is to galvanise learning between all community members. However, Williams (2017) indicated that the usefulness of a strict application of a community of practice model is questioned as it is difficult to be observed by studio tutors; the spaces of the studio are regarded as fields for the performative dimension of emerging habitus. In other words, it is still uncertain if this form of community of practice remains the same since students learn outside formal timetable activities, which means that students acquire architecture knowledge and skills based on peer learning without instructors' instructions.

Hence, students require a specific community of practice to achieve their peer learning activities that are constituted by shared knowledge and experiences rather than being designed by different individuals' behaviours. For example, Piper (2017) proposed a collaboratively student-centred learning model in art and design disciplines, bringing energy and enthusiasm to develop the community of practice, enabling individuals to enjoy the playfulness of practical studio activities in a non-hierarchical way. After all, learning in the community of practice has two connected dimensions - a social dimension and a material practising dimension. The social dimension is supported through social media, which requires the presence of other students and spaces available with the potential for occupation. Williams (2017) indicated that the material practising dimension is conditional upon having the suitable materials, equipment, spaces and the freedom to make a mess. However, Morton (2012) articulated that participation in the design studio learning environment does not follow a discrete community of practice model, as many students seek and find a form of legitimate peripheral participation outside their formal instruction in classes, which means that each individual student may actively engage in communities of practice that may not be practical for others. Shreeve (2007) argued that the provision of studio spaces for learning by doing, for material engagement and

exchange of practices between students and tutors, and also between students themselves, reflected characteristics of a community of practice model. However, the study was limited to examining what happened during organised studio sessions with tutors, so it did not explore whether and how the community of practice extended beyond these and how and whether students themselves sustained them.

As for the discipline of architecture, Nicol and Pilling (2000) argued that architecture in practice is a participative process involving communication with other educational and social roles in physical design studios. However, architectural schools, through both their formal structures and their informal socialisation processes, may not be thoroughly preparing students with the skills needed for participative practice, such as lacking systematic development or assessment of communication and interpersonal skills, little encouragement for students to share and develop their ideas with each other (Cuff 1991), and hierarchical patterns of interactions between the instructor and the students (Morton 2012).

After all, from previous related studies above, there have been many findings on contributions of students' active learning within physical design studios. Even though the theory of the community of practice was introduced to research students' peer learning activities, the researchers mainly focused on students' interactions between tutors and themselves within the formal pedagogies. In contrast, there have been no obvious findings on architecture students' interactive informal learning between peers and outside formal timetable activities via the lens of the community of practice.

Error! Reference source not found.2.3.2 The Community of Practice and Informal Learning between Peers outside Timetabled Educational Activities

Anggiani and Heryanto (2018) claimed that the current and future higher education pedagogy requires students with more creative and multidisciplinary thinking. However, Cox (2018) argued that conventional face-to-face teaching can no longer meet the requirements of various students' learning patterns in the future. Hence, Cox (2018)

claimed that educators and learners are introduced to conducting teaching and learning assisted by technology-based learning methods, especially virtual learning. Al-Arimi (2014) introduced that virtual learning is naturally suited for distance and flexible learning but can also be used in conjunction with face-to-face teaching, in which case the term "blended learning" is used. Anklam (2009) and Kaplan and Haenlein (2010) indicated that learning resources can be accessed independently of time and place with the assistance of virtual learning environments. Harrison and Hutton (2014) and King (2016) all argued that even though ample physical space is available to support collaborative work, virtual learning environments are the preferred spaces for students' collaboration. In addition, El-Hussein (2012) indicated that virtual learning environments can add value to formal timetable learning and enhance learners' overall learning experience.

Overall, based on these characteristics, it was found that traditional face-to-face learning assisted by virtual learning environments could also be applied via the lens of the community of practice. For example, Amin and Roberts (2008), as cited in Deakin et al. (2011), acknowledged that there are two types of virtual learning environments in which the community of practice can engage: the first type is applied to open-source project and a large number of participants can take part; the second type is aimed at solving particular problems, and the participants are usually a specific group of people, such as professionals, experts, lay people, and others in remote to advance knowledge within some specifically designed platforms.

Based on these two types, some previous researchers have explored the characteristics and merits of virtual learning environments via the lens of the community of practice. For example, Hildreth and Kimble (2000), as cited in Usoro et al. (2007), indicated that global asynchronous and real-time collaborations among organisations were achieved by creating virtual communities of practice. Similarly, Hara et al. (2009) indicated that the virtual community of practice can reduce the difficulties of geographical distributions, but most previous examples only discussed the utilisation of the community of practice in the online environment within the organisation context or a particular profession.

Besides, Frank et al. (2017), as cited in Hass et al. (2021), articulated that collaborations between companies in the form of the online community of practice could cross the boundaries of geography and policies, and employees could be more committed to the virtual communities of practice. It can be found from the above that there are common traits of engaging the community of practice in virtual environments, minorizing the geographical, cultural, and political differences. However, those explorations of virtual communities of practice were all based on business companies or other disciplines in higher educations, which means that it has yet to be discover whether the theory of virtual communities of practice can generate similar outputs in architectural education and architecture students' informal learning experiences. Nevertheless, these two types of virtual communities of practice provide this thesis with a reference to explore the modes of students' informal learning between peers when they study outside timetabled educational activities via the lens of the community of practice.

2.3.3 The Community of Practice and Informal Learning between Peers outside Physical Design Studios

Hettithanthri and Hansen (2022) articulated that the physical design studio should undertake the role of cultivating students' creative thinking and problem-solving abilities through perspectives even when students are outside the physical design studio. Regarding architecture students' informal learning between peers outside physical design studio, Achten et al. (2011) and Pak et al. (2012), as cited in Ioannou (2018), have all attempted multiple times to introduce virtual learning environments to assist with physical design studio. Chen (2016) demonstrated that although architectural students can acquire knowledge and other useful information from face-to-face interactions, they still highly rely on virtual means to obtain what they cannot learn from their tutors and peers. As a result, Ioannou (2018) indicated that virtual learning in remote ways is increasingly involved in design studio education, identifying that the virtual learning environments can provide opportunities for students to interact socially and culturally with their peers, which seems that this social interaction motivates the students who value absorbing

knowledge through interacting with their studio mates and friends. For example, Vosinakis and Koutsabasis (2013) articulated that through some virtual learning environments (including virtual design studio and virtual communication tools for students' interactions from different disciplines), students can still share their learning materials, design thinking, and design practice with their peers, supporting discussion, refinement, and future reference. Likewise, Jones and Dewberry (2013), as cited in Yu et al. (2022), indicated that relative digital applications of architecture and increasingly distant professional collaborations encouraged architecture students to conduct basic communications and discussions in distance and online.

By contrast, some other previous researchers claimed that architecture students' informal learning activities between peers are affected to some extent outside physical design studio, especially the significant decline in peer-to-peer interactions among students when they study within the virtual environment. For example, Güler (2015) stated that students still cannot interact with peers or the instructor properly as they do in physical design studios, especially in asynchronous alternatives. Likewise, Carter and Doyle (2015) claimed that virtual learning environments assisting with design studios must (at the very least) effectively simulate the tropes of the "face-to-face studio model". Even further, Pektaş (2015) developed a blended-learning design studio, facilitating collaboration between interior architecture students from two universities in Turkey and USA. The initial stage of the design project was on site, and the subsequent processes were experienced remotely assisted by some online communicative tools such as Moodle (a Learning Management System), Skype and Facebook, providing a setting for a rehearsal of future workplaces and helping prepare students for global, networked, and competitive professional design practices. Ultimate, Pektaş (2015) concluded that students' views on traditional studio teaching are still very positive even though they were introduced to a virtual learning environment project for a long time, and some of them even indicated that traditional face-to-face education is an indispensable part of design education.

Therefore, architecture students' peer learning activities have limitations outside the physical design studio.

This phenomenon was more obvious when the COVID-19 pandemic began. For example, Komarzyńska-Świeściak et al. (2021) indicated that all educational and study processes in architectural education were moved into online and virtual environments without preparation. As a result, architectural education and learning experienced various differences during the initial period of the pandemic, and those difficulties were detected in some previous research. For instance, Iranmanesh and Onur (2021) measured students' evaluations of their learning performances within two programmes conducted in virtual learning environments in eight architectural institutions during the COVID-19 pandemic. The item targeting peer learning scored the lowest compared to other activities, and 3rd- and 4th-year students had less motivation to engage in peer learning when they worked in virtual learning environments compared to within physical design studios. This was expected as they would have had more time to form stronger bonds and a social structure amongst themselves compared to 1st- and 2nd- year students, but those bonds could not be constructed within virtual learning environments.

Besides the lack of peer learning, Saghafi et al. (2012) argued that the introduction of virtual learning environments into physical design studio leads alienation, confusion, and loss of identity. This phenomenon was demonstrated during the period of COVID-19 lockdown. For example, Stoytcheva (2021) indicated that peer-to-peer and cognitive learning activities were achieved in the long term when students study within the learning community in virtual environments, which caused a sense of isolation. Brodie and Osowska (2021) also agreed that the process of creating peer-to-peer engagements between students within the virtual learning community was longer than within the physical one. Thus, these arguments are valued to be tested in this thesis.

Due to the lack of peer-to-peer interactions within the learning community when architecture students study in virtual environments, it is difficult for them to maintain their informal learning between peers in the form of a community of practice when they

are outside physical design studio. This is the reason why previous studies have rarely discovered if the theory of the community of practice can bring benefits to architecture students' learning experiences outside physical design studio, even though some positive aspects of the community of practice were detected when students studied within physical design studio (such as Sariyildiz 2010; Morton 2012; Williams 2017).

2.4 Summary

Accordingly, the concept of the "community of practice" in architectural education can be regarded as the learning community that is self-organised by architecture students' informal learning experiences between peers outside formal timetable activities. Specifically, various interactions during informal learning between peers are regarded as mutual engagement; the learning environment and atmosphere within in can be deemed a joint enterprise; stories and memories occur in the process of informal learning between peers belong to a shared repertoire. However, previously related studies mainly consider formal education as the community of practice, ignoring the significance of students' informal learning between peers to the constitution of the community of practice. Hence, this thesis aims to discover the potential application of that informal learning in the architecture discipline, to explore how these informal learning experiences of architecture students constitute communities of practice. In addition, the modes and specific characteristics of informal learning between peers via the lens of three attributes of the community of practice are determined to be explored in this thesis.

As all the contents stated above, research on architecture students' learning activities between peers has brought some achievements since the end of the last century, such as the influence factors on students' learning activities within the physical and/or virtual studio, and the differences between students' learning activities within the physical design studio and virtual environments; yet, Marshalsey and Sclater (2020) claimed that there has been little research on the specific ways that students experience changes, difficulties, and novelties of informal learning between peers when the learning environments were converted from the physical to the virtual. It means that such precedent literature has yet

to generate a systematic synthesis of evaluating the specific ways that students experience different, unique or specific informal learning between peers when they are engaged in physical and virtual learning environments. To fill the gap, some previous researchers explored whether the theory of the community of practice can solve such problems (such as Usoro et al. 2007; Barnett et al. 2012; Piper 2017; Haas et al. 2021), and some other introduced that theory into architectural education to discover the ways that the community of practice solves traditional problems of design studio education in the architectural discipline (such as Tunçer and Sariyildiz 2010; Morton 2012; Williams 2017). However, they still have yet to research architecture students' informal learning experiences and outside formal pedagogies, let alone such experiences within the virtual learning environment.

To fill the gap and align with the future trend of the architecture discipline, this thesis focuses on architecture students' informal learning between peers and outside formal timetable activities, to further provide future related research with references for designing and reconstructing design studios accommodating students' informal learning between peers via the lens of the community of practice. The next chapter presents the methodological framework for this thesis based on the theories from the related studies mentioned above.

CHAPTER THREE

First-Phase Study: The Basis for the Research Data

3.1 Introduction

This chapter presents the arrangement and findings of the first-phase study. Specifically, the first section shows the arrangement of the first-phase study for this thesis. The second section illustrates the findings from interviewees' narratives, identifying the significance of the physical design studio to students' informal learning experiences between peers from four aspects. This chapter ends with the analysis of the first-phase study's findings, classifying three thematic categories of students' informal learning between peers when students studied within different learning environments. The research methods and findings of the first-phase study will assist in generating those of the second-phase study, which also refers to the main study process.

3.2 Arrangement of the First-Phase Study and Its Relationship with the Second-Phase Study

The first-phase study, which aimed to identify if the design studio learning environment has impacts on architecture students' informal learning between peers, was conducted during the period of "work from home". In addition, since the "work from home" policy prevented students from studying with peers face-to-face within the design studio learning environment during the pandemic, it provided this thesis an opportunity to identify those aspects. In a word, this phase was derived by a tough time that architecture students were forced to engage in informal learning activities without the design studio learning environment in physical design studios, to find out what aspects were missed when the design studio learning environment generated from physical design studios was taken away. However, the first-phase study was not used to frame the methodology for the main study, since this phase was conducted without the theoretical framework of "community of practice". Even though, the methods and findings of the first-study still

assisted in designing those of the second-phase study. The relationship between these two phases and the step-by-step procedure of both phases is stated below:

1. Conduct a small-scale interview targeting undergraduate architecture students, who experienced the transition of learning environments from physical to virtual ones, at the Welsh School of Architecture, Cardiff University. Record their narratives of their real stories of informal learning within the physical design studio and other spaces outside it through semi-structured interviews. Thus, the questions asked for interviewees were all designed to know their experiences of informal learning between peers within physical design studios before the pandemic and the ways that they maintain such learning during the "work from home" period of COVID-19 pandemic.
2. Based on the findings of the first-phase study, design the structure, arrangement, and questions for implementation the second-phase study for some volunteered students in the form of observations. The questions asked for study participants were all designed to know their specific ways of experiencing informal learning between peers within physical design studios and other spaces, such as non-timetabled learning spaces on and off campus. This phase initially takes field notes of those students' informal learning experiences after class at the Welsh School of Architecture. According to the observation field notes and findings, this phase subsequently conducts interviews and focus groups with those observed students and some other individuals (including the academics with oversight of each cohort, referred to as the Year Chair in the following part of this thesis) at this school.

To collect related data, some previously related studies applied qualitative methods to collect students' learning experiences and assessments, thereby providing this study with references for data collection methods to answer the research question. Referring to the specific methods for data collection, researchers in some previous related studies focused on determining the relationship between the learning behaviours of studio users (students and the studio tutor) and other aspects within conventional design studios or virtual

environments. Gopaldas (2016) indicated that qualitative methods include asking semi-structured and open-ended questions in interviews. Likewise, Budge et al. (2013) indicated that the mainly used qualitative approach to manage students' accounts of learning experiences was asking students open-ended and/or semi-structured questions in the form of individual/focus-group interviews. As shown in Table 3, for example, students' behaviours and activities were investigated using some specific qualitative approaches to explore the deep and underlying rationales and mechanisms.

Table 3 The Literature That Only Used Qualitative Approaches

Researchers	Project	Aim	Attendant	Data Collection Methods
Morton (2012)	Large well-established architecture school in an Australian university	To analyse the social and linguistic organisation of routine practices in one design studio, and to identify who occupied the roles of expertise.	A studio instructor and 15 students in the fourth and final academic year	Recorded videos, with follow up semi-structured interviews with students and tutors.
Budge et al. (2013)	A textile design programme	To explore the complexity of creativity and peer learning within design studios.	Undergraduate students	Interview in focus group and survey.
Williams (2017)	A UK school of architecture with a typical studio arrangement	To explore the social community patterns and activities within the studio space and numerous working spaces; as well as the various formal and informal events associated with the design studio teaching itself.	Some final-year undergraduate students	Semi-structured interviews, supported with elicitation techniques to encourage rich responses.
Rodriguez et al. (2018)	A programme combines conventional studio, virtual learning environment and, live projects	To assess students' perceptions of their learning within physical design studio and virtual learning environments	Undergraduate and postgraduate students / Teachers	Focus group interviews with students and peer review by teachers / Photographs, videos and notes
Marshalsey and Sclater (2020)	An online studio	To investigate which platforms, strategies, tools and techniques may support student engagement in design-related education online.	Undergraduate and postgraduate students / Staff	Focus group with 19 open-ended and semi-structured questions.

As stated above, the interview in the first phase was applied to collect the general issues that occurred as the discipline of architecture transitioned from the physical to the virtual learning environment. Thus, the interview aimed to understand some students' experiences and perspectives of informal learning between peers due to the transition and to allocate the questions for the second phase study.

3.3 Structure of the First-Phase Study

3.3.1 Questions Designed for the First-Phase Study

To identify if the physical design studio has impact on architecture students' informal learning between peers, the questions asked of study participants in the first-phase interview are divided into two main themes. The aspects of those questions involve the change of learning environments from the physical to the virtual ones, the informal learning activities within such learning environments, and the suggestions for improving those questions.

Specifically, the first theme is to discover in what ways students have coped with the changes of learning environments since the "work from home" policy was introduced from mid-March 2020 due to the COVID-19 pandemic. The first main question is "How do you undertake your design studio learning since the pandemic? And what do you think about it? Please narrate the experiences, changes, difficulties, and novelties you did." The investigator asked more detailed follow-up questions if the interviewees' narratives were not related to the expected responses (the following questions are illustrated in the Appendix). In addition, to find out the specific ways that the environment changes influence their learning experiences and how students cope with them, students were also asked "Could you please think about a specific project and talk about how the studio helped you to develop that project? How about group work, and how the studio helps with this?"

Furthermore, the second theme is to find out what informal learning activities students usually do within design studios and how these activities convert from physical into virtual environments. The first question is "What activities do you typically undertake individually and/or collaboratively within the design studio?" The second question is "Have you been able to undertake these activities online since the pandemic? If so, how well have these translated into virtual activities?"

3.3.2 Sampling of the First-Phase Study

As undergraduate architecture students are selected as sample cases, to ensure the fairness of sample selection, systematic sampling (Singh and Mangat 1996) was applied to elicit appropriate volunteers among the population of all 2nd- and 3rd-year students in the Welsh School of Architecture. Generally, as stated by Singh and Mangat (1996), within the systematic sampling method, only the first research participant is selected randomly, the rest are automatically selected based on a predetermined pattern. For instance, within this the first-phase study of this thesis, the first potential participant was randomly selected, and the remaining participants were selected sequentially, one out of every ten from the student list. Regarding the sample size of the interview, qualitative research is usually not suitable for collecting data from common and large-scale objects (Mohajan 2018). Thus, data saturation, which is the point at which no new information or themes occur in the data from the completion of additional interviews or cases (Guest et al. 2006), can generally be a reference to determine the number of interview participants. For example, within the first-phase study, 25 students were invited, and 9 out of those 25 students attended the trial interview. Data saturation was reached at the seventh student, because the last two students did not express anymore novel viewpoints on informal learning experiences within physical design studios and separated virtual learning environment.

In the first phase of this study, study participants were directly invited from 2nd- and 3rd-academic-year students, who experienced both learning environments within the physical design studio and virtual contexts, from the Welsh School of Architecture. These two characteristics ensure both the diversity and generality of the sample. Specifically, there were totally 114 2nd-year students, where female took up 52%, male took up 48%, home students took up 71%, and international ones took up 29%. There were totally 125 3rd-year students, where female took up 58%, male took up 42%, home students took up 62%, and international ones took up 38%. As for the categorisation of different interviewees, they were numbered as Student 1, 2, 3…9, and then there were also sub-groups divided

by students' academic years, which were Year 2 and Year 3 for those students. Table 4 illustrates the information of each interviewee.

Table 4 The Basic Information of Interviewees in the First-Phase Interview

Identity	Academic Year	Gender	Duration	Home / International Student
Student 1-Year 3	2020-2021	Female	13 minutes	Home
Student 2-Year 2	2020-2021	Female	16 minutes	Home
Student 3-Year 3	2020-2021	Male	20 minutes	International
Student 4-Year 2	2020-2021	Female	10 minutes	International
Student 5-Year 3	2020-2021	Male	11 minutes	Home
Student 6-Year 3	2020-2021	Male	23 minutes	International
Student 7-Year 2	2020-2021	Male	9 minutes	International
Student 8-Year 2	2020-2021	Female	12 minutes	International
Student 9-Year 2	2020-2021	Female	11 minutes	International

3.3.3 Procedure of the First-Phase Study

The first-phase study was conducted from October 2020 to January 2021. As the systematic sampling method was applied to find volunteers, one out of every ten of those students received the interview invitations email. There were 254 students in 2nd- and 3rd-year, so twenty-five of them received the invitation, and nine of these students accepted to attend the interview, recording narratives of their learning experiences within their design studios and other spaces from March 2020 to November 2020. After obtaining approval for the ethic procedure at the beginning of October 2020, the investigator sent the sample invitation email to all those twenty-five students during the third week of October 2020. Interviews were conducted from 27th October 2020 to 20th November 2020, and the collected data were then analysed from mid-November 2020 to early January 2021.

As for the data collection process, video interviews commonly last between 15 to 90 minutes (REED 2021). The average time of each first-phase interview was 14 minutes and 6 seconds, and the longest one is 22 minutes and 42 seconds. The duration of those interviews was relatively short as students could not remember very well all their learning experiences and changes since the pandemic during that short time. In addition, interviewees' responses and narratives were usually subjective, so they might not be regarded as students' literal learning experiences. Therefore, in the second phase, as stated

by McCombes (2019), one probability sampling method will be adopted for the sampling to ensure statistically solid inferences of the whole group of students.

3.4 Findings from the First-Phase Study

3.4.1 Analysis of the Data from the First-Phase Study

As the first-phase study was conducted online via Microsoft Teams, study participants' narratives were recorded and interpreted into transcripts. Those transcripts of students' narratives elicited from the interviews were further classified into specific categories based on their mutual characteristics, followed by analysing those data. Specifically, videos of first-phase interviews were recorded by Microsoft Teams, which automatically generated transcripts on Microsoft Stream, and the author reconfirmed with the interviewees to check the corrections of the transcripts. Subsequently, those transcripts were coded into different categories through NVivo, according to the mutual features and categories of informal learning activities.

Accordingly, the main categories were ultimately interpreted as "design studio learning environment", "peer-to-peer engagement", and "personal acquisition". Detailed descriptions of those thematic categories are shown in **Error! Reference source not found.**. The thematic map that consists of quotations, key-wards, original coding, initial themes, are illustrated in Figure 2, Figure 3, and Figure 4. The findings in this chapter offer this thesis fundamental findings of the mutual characteristics of architecture students' informal learning activities within the physical design studio and virtual environments. By collecting the learning experiences of volunteered interviewees within physical and virtual environments, these findings identified the significance of the physical design studio and the learning environment it generates for architectural learning activities. The findings from the first phase of the study reveal that the design studio learning environment represents the learning environment of the community of practice. This analysis method offers this thesis a reference that the data collected from study participants can undergo thematic analysis based on the thematic categories of the data.

Table 5 Different Thematic Categories of Date Collected from the First-Phase Interview

Themes	Design Studio Learning Environment	Peer-to-Peer Engagement	Personal Acquisition
Specific indication	The design studio learning environment where people are around doing their own learning and other tasks is significant to architecture students' learning wherever within or outside physical design studios	Within the design studio learning environment, students share their design thinking, learning materials, process work and design products with others, do casual conversations, or just be with other students.	Within the design studio learning environment, students get motivations, such as work harder, from others.

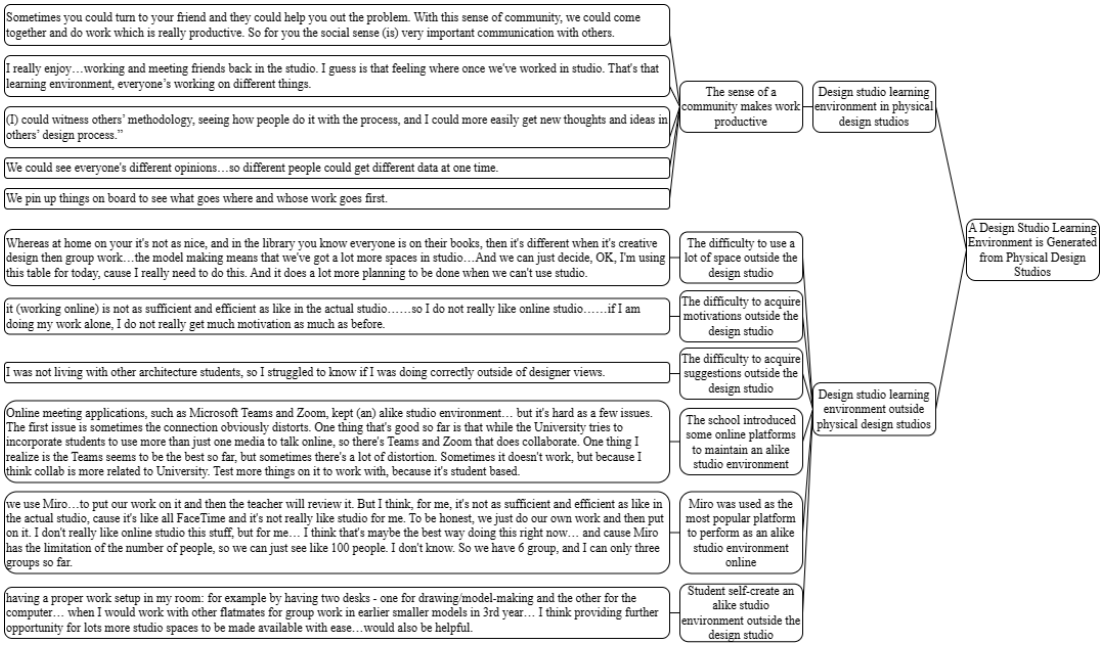

Figure 2 The Coding Process of the First Theme "Design Studio Learning Environment"

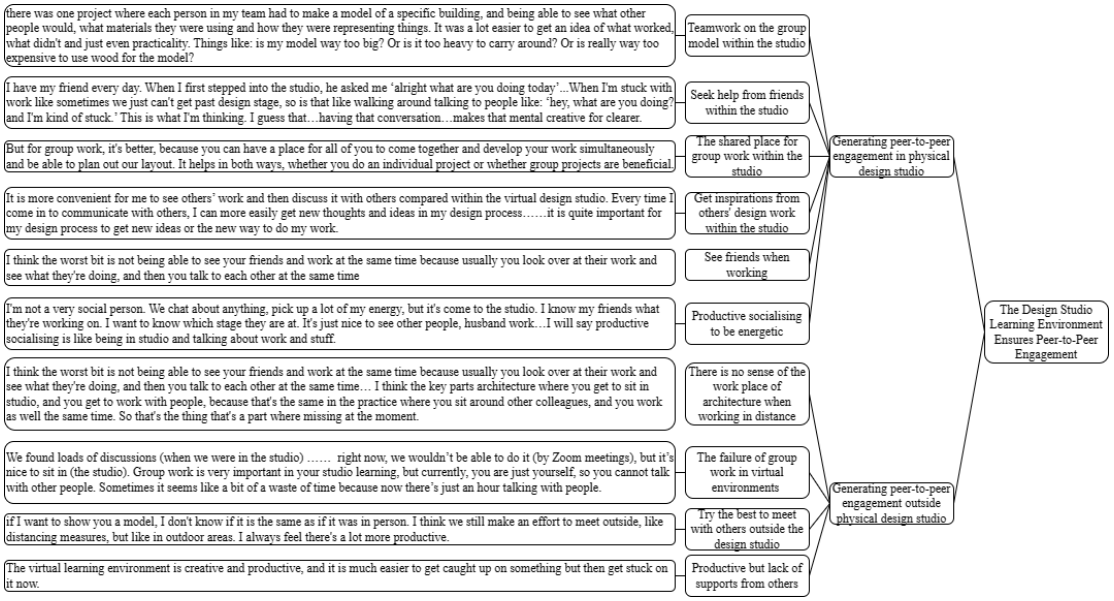

Figure 3 The Coding Process of the Second Theme "Peer-to-Peer Engagement"

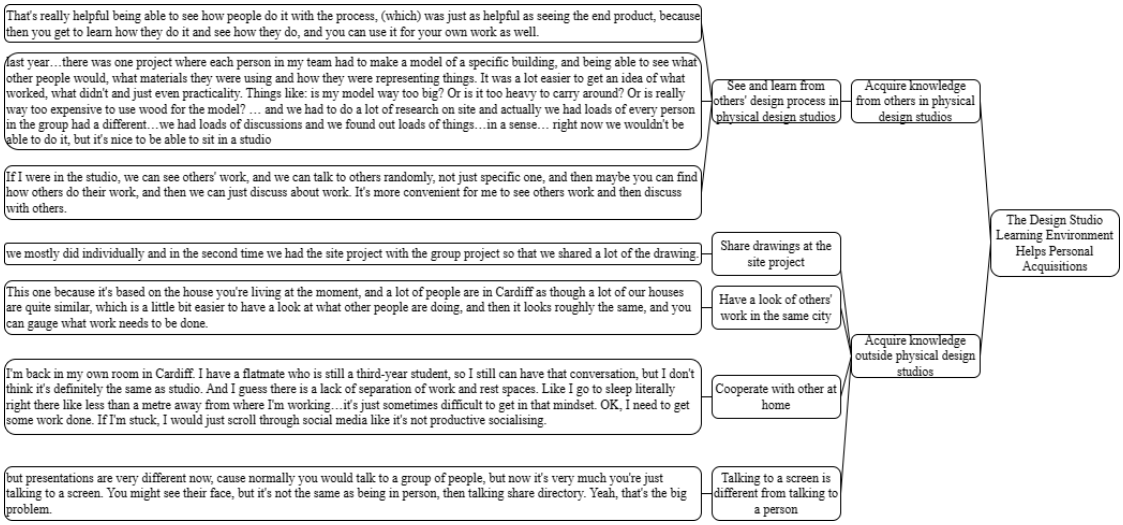

Figure 4 The Coding Process of the Third Theme "Personal Acquisition"

The following three sub-sections present three thematic aspects of the ways that the design studio learning environment impacts on architecture students' informal learning experiences between peers.

3.4.2 The Design Studio Learning Environment within and outside Physical Design Studios

The first aspect pertains to the fact that the design studio learning environment, where students can present together but work independently, can be achieved within and outside physical design studios. Specifically, the narratives of all nine interviewees revealed that the traditional design studio offers students a space to learn and develop their work in the form of multiple learning communities, which create a design studio learning environment where everyone can obtain help at any time and in any way (as shown in Table 6). After all, students gradually became accustomed to the learning environments they were engaged in, feeling that they belonged to the design studio learning environment constituted by physical design studios.

Table 6 Students' Opinions on Learning as A Community

Student	Quotations
Student 1-Year 3	"We could see everyone's different opinions…so different people could get different data at one time."
Student 2-Year 2	"Each person in the group makes a model, showing studio mates with a model / physically holding a model and talking about it."
Student 3-Year 3	"(I) could witness others' methodology, seeing how people do it with the process, and I could more easily get new thoughts and ideas in others' design process."
Student 4-Year 2	"We pin up things on board to see what goes where and whose work goes first."
Student 6-Year 3	"…I really enjoy…working and meeting friends back in the studio. I guess is that feeling where once we've worked in studio. That's that learning environment, everyone's working on different things."
Student 7-Year 2	"Working in the studio was better, because we had a drop in sessions from ice mark students, and they would provide some guidance which was better, because you're learning from other students. Sometimes you could turn to your friend and they could help you out the problem. With this sense of community, we could come together and do work which is really productive. So for you the social sense (is) very important communication with others."

However, the "work from home" policy disrupted such a design studio learning environment, separating students from their learning communities. When they were learning online at their own homes, they all felt isolated. In addition, this policy also made students difficult to do some design work, such as making physical models, due to the lack of learning spaces within their own home. Table 7 illustrates some perspectives on learning outside physical design studios, especially within virtual learning environments, from some interviewees.

Table 7 Students' Opinions on Learning outside Physical Design Studios

Student	Quotation
Student 1-Year 3	"Whereas at home on your it's not as nice, and in the library you know everyone is on their books, then it's different when it's creative design then group work…the model making means that we've got a lot more spaces in studio…And we can just decide, OK, I'm using this table for today, cause I really need to do this. And it does a lot more planning to be done when we can't use studio."
Student 4-Year 2	"I was not living with other architecture students, so I struggled to know if I was doing correctly outside of designer views."
Student 6-Year 3	"If we wanted to show their own model, it was not known if it is the same as it was in person."
Student 7-Year 2	"……I guess that there is a lack of separation of work and rest spaces (in my own room) ……If I am stuck, I would just scroll through social media, but it is not productive socialising."
Student 8-Year 2	"it (working online) is not as sufficient and efficient as like in the actual studio……so I do not really like online studio……if I am doing my work alone, I do not really get much motivation as much as before."
Student 9-Year 2	"It would be very difficult if they would like to do some group models online."

Although learning in isolation made it challenging to maintain a studio atmosphere outside physical design studios especially in virtual learning environments, some online platforms were still introduced by the university to preserve this design studio learning

environment. For example, Student 1-Year 3 mentioned some online platforms that the university introduced to maintain a similar design studio learning environment for architecture students:

> *Student 1-Year 3: "Online meeting applications, such as Microsoft Teams and Zoom, kept (an) alike studio environment… but it's hard as a few issues. The first issue is sometimes the connection obviously distorts. One thing that's good so far is that while the University tries to incorporate students to use more than just one media to talk online, so there's Teams and Zoom that does collaborate. One thing I realize is the Teams seems to be the best so far, but sometimes there's a lot of distortion. Sometimes it doesn't work, but because I think collab is more related to University. Test more things on it to work with, because it's student based."*

As for the most popular online platform to maintain an alike studio, it was known from students that Miro[1] has been widely used at the latter stage of the "work from home" period. For instance:

> *Student 2-Year 2: "a 'shared trauma'…allows a more trusting environment for presentations and the revelation of ideas, and, if work was to be taken or copied or mimicked in anyway (as it is scarily easy to do so now with Miro), it is a lot easier to see where the ideas come from, and where the derived ideas come from. Ultimately this (environment)…would most inspire students to work even harder and remember that they're contribution matters as much as the rest of them…"*
>
> *Student 4-Year 2: "Miro has a studio feeling, and it is nice to share and discuss everyone's work, even though it is different from physically being there."*
>
> *Student 7-Year 2: "…we would just have Zoom meeting and it was a bit more hectic to correct mistakes. But this time with the use of Miro…and it has more of a studio feeling, because you can see other people's work. Yeah, so it's a bit this semester compared to last semester."*
>
> *Student 8-Year 2: "…we use Miro…to put our work on it and then the teacher will review it. But I think, for me, it's not as sufficient and efficient as like in the actual studio, cause it's like all FaceTime and it's not really like studio for me. To be honest, we just do our own work and then put on it. I don't really like online studio this stuff, but for me… I think that's maybe the best way*

[1] Miro is a platform for modern work, enabling collocated, distributed, and remote teams to communicate and collaborate across formats, tools, channels, and time zones - without the constraints of physical location, meeting space, and whiteboard.

doing this right now… and cause Miro has the limitation of the number of people, so we can just see like 100 people. I don't know. So we have 6 group, and I can only three groups so far."

Even though a similar design studio learning environment was generated online, interviewees indicated that they still tried their best to self-organise a comparable physical design studio learning environment when they were studying at home during the "work from home" period. As shown in Table 8, some representative responses are presented as comprehensive examples of creating a comparable design studio learning environment.

Table 8 Examples of Self-Creating Design studio learning environment outside Formal Timetable Activities

Participants.	Student opinions
Student 5-Year 3	"…having a proper work setup in my room: for example by having two desks - one for drawing/model-making and the other for the computer… when I would work with other flatmates for group work in earlier smaller models in 3rd year… I think providing further opportunity for lots more studio spaces to be made available with ease…would also be helpful."
Student 4-Year 2	"I went to each other's house to do work or did video calls all the time while they sat at their desks doing work."
Student 2-Year 2	"…to create an alike studio environment, I set up a studio-like desk space for work and stick the drawings on the walls like in the studio."
Student 6-Year 3	"…we did weekly/biweekly presentations of work…to get a sense of others' work (like studio) and could ask questions after…we often met up in cafes or booked studio slots…We had a shared google drive which we uploaded the latest versions of drawings etc…"
Student 9-Year 2	"…We…all the flatmates were doing the same course, so setting up tables into an impromptu three-person studio at the back of our kitchen…Regular presentations with required 'finished' pin-ups could be quite helpful for keeping on track…of how far along you are…"

It is notable from the above that interviewees all emphasised that they could readily obtain support from others when they studied within the design studio learning environment generated by the physical design studio.

3.4.3 The Design Studio Learning Environment Generates Peer-to-Peer Engagement

The second aspect refers to the fact that the design studio learning environment generated by physical design studios maintains students' peer-to-peer engagement, encompassing both physical and mental aspects. Specifically, students could obtain physical assistance and ideas from discussing with others when they were working together. For instance, Student 4-Year 2 gave an example of his design project that occurred before the pandemic, indicating the discussion of ideas between him and his fellows on the site:

Student 4-Year 2: "We did a large group project on analysing site, and that worked really nicely in Bute building [the school building of the Welsh School of Architecture]…working…till night, we could all have a different view of how to use the site, and it was fascinating seeing everyone's different opinions on how they thought this site would work based on. Like the same evidence that we do, collected together, and I thought it was really interesting."

Likewise, Student 6-Year 3 proposed a typical view of architecture students' interaction mode when they studied within the physical design studio:

Student 6-Year 3: "…I have my friend every day. When I first stepped into the studio, he asked me 'alright what are you doing today'...When I'm stuck with work like sometimes we just can't get past design stage, so is that like walking around talking to people like: 'hey, what are you doing? and I'm kind of stuck.' This is what I'm thinking. I guess that…having that conversation…makes that mental creative for clearer."

However, the "work from home" policy made peer-to-peer engagement challenging. For example, Student 1-Year 3 indicated a typical viewpoint on the lost peer-to-peer engagement since they were moved online and working separately:

Student 1-Year 3: "Each person in my team had to make a model of a specific building and be able to see what materials they (other people) were using and how they were representing things. It was a lot easier to get an idea of what worked, what didn't and just even practicality. Is my model way too big? Or is it too heavy to carry around? Or is it too expensive to use wood for the model? Right now, we wouldn't be able to do it (online)."

Similarly, the narratives of some interviewees disclosed that although some students have attempted to carry out peer-to-peer engagement well within the virtual environment during the pandemic, most of them still need to catch up for face-to-face interactions. For example:

Student 1-Year 3: "We found loads of discussions (when we were in the studio) …… right now, we wouldn't be able to do it (by Zoom meetings), but it's nice to sit in (the studio). Group work is very important in your studio learning, but currently, you are just yourself, so you cannot talk with other people. Sometimes it seems like a bit of a waste of time because now there's just an hour talking with people."

Student 4-Year 2: "The key parts of learning architecture are sitting and working with people in the studio, because I think that it is the same in the practice where I sit around other colleagues when I work in the future……"

Student 6-Year 3: "…if I want to show you a model, I don't know if it is the same as if it was in person. I think we still make an effort to meet outside, like distancing measures, but like in outdoor areas. I always feel there's a lot more productive."

Student 7-Year 2: "……It is more convenient for me to see others' work and then discuss it with others compared within the virtual design studio. Every time I come in to communicate with others, I can more easily get new thoughts and ideas in my design process……it is quite important for my design process to get new ideas or the new way to do my work."

Even though, some other interviewees identified positive aspects of working in virtual environments remotely, which aided students' collaborations. For example:

Student 2-Year 2: "The virtual learning environment is creative and productive, and it is much easier to get caught up on something but then get stuck on it now."

Student 3-Year 3: "We worked in different groups and then what they did was their scheduled. They always have different seminars, and what we do is giving us a project, but at the beginning of it will do a draft, or just like initial stage through the project will put some stuff together at presentation about topic, and then they'll have hit me up online. But this is different sections, so we're not meeting…so we just get the chance to interact with other groups. Also listen to what other groups are doing, which is also something that's really good."

Student 9-Year 2, likewise, thought that the virtual learning experience was quite pleasant for discussion, indicating that:

Student 9-Year 2: "……It does not have some difficulties in talking out and discussing our project…… we have a team for Chinese people……so sometimes it is easier to speak Chinese (to my classmates)…I got used to engaging with others via WeChat, which could afford multiple functions of interactions, asking for learning materials, sharing knowledge, purchasing books, organising group chats, etc. Thus, it was not a big deal of peer learning in the virtual environment for we Chinese students …Otherwise, we were taught to use the Miro to upload and share progress materials, and everyone could see others' work there…just like learning within our studio."

It is notable from the above that the design studio learning environment, which was generated by the physical design studio, ensured the high efficiency and effectiveness of students' peer-to-peer engagement. Even though some online platforms formed the soft connections between students, some students were still not accustomed to interacting on those platforms.

In addition, the design studio learning environment provide architecture students with a place for their daily socialisation. In other words, the design studio learning environment enables students not only to engage in informal learning activities between peers but also to spend their time outside formal timetable activities rather than studying alone at home or in libraries. Specifically, some interviewees emphasised that they could maintain their non-study related interactions, such as witnessing others' present and having casual chats without discussing their design projects, within physical design studios outside formal timetable activities. For example:

> *Student 5-Year 3: "I think the worst bit is not being able to see your friends and work at the same time because usually you look over at their work and see what they're doing, and then you talk to each other at the same time."*
> *Student 6-Year 3: "I'm not a very social person. We just chat about anything, pick up a lot of my energy, but it's come to the studio. I know my friends what they're working on. I want to know which stage they are at. It's just nice to see other people, husband work…I will say productive socialising is like being in studio and talking about work and stuff."*

However, "work from home" policy disrupted students' non-study related interactions when they studied within their own homes. That led to some adverse effects on students' learning, such as loss of focus and isolation in a unity. For example:

> *Student 3-Year 3: "I was unhappy with their eyes were really not happy with the line was messed up…But one thing that I did was the deal breakers in subgroups. So instead of just speak into the tears to the subgroup, so you can speak to actually out students as well. And that can bring attention down for some students, not for me, cause I asked to speak to anyone."*
> *Student 5-Year 3: "I think the worst bit is not being able to see your friends and work at the same time because usually you look over at their work and see what they're doing, and then you talk to each other at the same time… I think the key parts architecture where you get to sit in studio, and you get to work with people, because that's the same in the practice where you sit around other colleagues, and you work as well the same time. So that's the thing that's a part where missing at the moment."*

It is notable from the above that students generally had visual contacts or casual chatting with their friends and study fellows within physical design studios, rather than always discussing design projects. However, the online environment disrupted those non-study related interactions.

3.4.4 The Design Studio Learning Environment Helps Personal Acquisitions

The last aspect refers to that the design studio learning environment assists architecture students in their personal acquisitions from the outside world when students are outside formal timetable activities. Interviewees all pointed out their personal acquisitions when they were studying within physical design studios where others were present, such that they could obtain help and motivations from others even without direct interactions with them. For example:

> *Student 1-Year 3: "…last year…there was one project where each person in my team had to make a model of a specific building, and being able to see what other people would, what materials they were using and how they were representing things. It was a lot easier to get an idea of what worked, what didn't and just even practicality. Things like: is my model way too big? Or is it too heavy to carry around? Or is really way too expensive to use wood for the model? ... and we had to do a lot of research on site and actually we had loads of every person in the group had a different…we had loads of discussions and we found out loads of things…in a sense… right now we wouldn't be able to do it, but it's nice to be able to sit in a studio..."*
> *Student 3-Year 3: "...I think that's really important because sometimes when you're even though working in a group…like communicating you're aiming at the same level. You don't know what other groups are doing, so you might not understand something, because you are in the same bubble, but when you get to present our groups we get to see other people's presentation. I would up you know the other side of our groups. You can understand more about the topic or the subject. You can have more an idea to get me. When is the interaction between two different types of groups, you can gain more knowledge on the topic. You can ask more questions, and then you can also get really inspired by what other people vice versa. So I think that was really helpful with we just finished that now and then will we have to write an essay as well, and then that's the essay that we had to do a seminar in the summer."*
> *Student 4-Year 2: "I would say the main one for me is the mentality of it, so you're in amongst everyone, and you're all working towards roughly the same things, so you always have that reminder of I'm not alone in my struggles, and it's also nice to witness the work of others for inspiration much more readily than you can online…I would say so, because you're not just seeing other peoples work. You're also witnessing their methodology."*
> *Student 8-Year 2: "If I were in the studio, we can see others' work, and we can talk to others randomly, not just specific one, and then maybe you can*

find how others do their work, and then we can just discuss about work. It's more convenient for me to see others work and then discuss with others."

However, the "work from home" policy made it challenging to acquire knowledge, inspirations, and motivations from others. For example:

Student 8-Year 2: "…after pandemic you need to do your work on your own and then you are not able to get that feedback immediately as well…that's the big the difference between those two for me…if you're doing your work alone, I don't really get much motivation as much as before…Every time we come in at communicate with others we can more easily get new thoughts and new ideas in our design process. So I think that's quite important for my design process to get new ideas or the new way to do my work."

Some interviewees mentioned that, during the period of "work from home", to maintain personal acquisition as when studying within the design studio learning environment, the place where students lived could have a significant impact on it. For example:

Student 4-Year 2: "… some people are living with other architecture students, but I'm not, so I found it a bit of a struggle. I'm supposed to know if what I'm doing is correct outside of designer views every other week, because we have an online micro space that's nice in the everyone's work is on there all the time, but it's also just not the same as like physically being there."

Student 5-Year3: "… it's based on the house you're living at the moment, and a lot of people are in Cardiff as though a lot of our houses are quite similar, which is a little bit easier to have a look at what other people are doing, and then it looks roughly the same, and you can gauge what work needs to be done."

Student 6-Year 3: "but as soon as I got home, and started talking to my tutors on learning central Blackboard, which was a lot better. I really appreciate that I can still communicate with them, although it's not the same way. I can see the sketches fully pull-out tracing paper, and like just sketch on my schedule over my drawings, but at least they still do a bit of scribbling, with the mouse pad drawing on my uploaded work, so that was quite alright."

Some interviewees indicated that the online platforms could be regarded as an alternative measure to be motivated by seeing others, but the effectiveness was not as good as within physical design studios. For example:

Student 5-Year 3: "I think it did help, and being able to see everyone's work was really good as well, because we put all of our work online now as well. That's really helpful being able to see how people do it with the process, (which) was just as helpful as seeing the end product, because then get to learn how they do it and see how they do. Then you can copy that, and you

can use it for your own work as well. So that was pretty good…you would talk to a group of people, but now…you're just talking to a screen. You might see their face, but it's not the same as being in person…that's the big problem."
Student 6-Year 3: "I'm back in my own room in Cardiff. I have a flatmate who is still a third-year student, so I still can have that conversation, but I don't think it's definitely the same as studio. And I guess there is a lack of separation of work and rest spaces. Like I go to sleep literally right there like less than a metre away from where I'm working…it's just sometimes difficult to get in that mindset. OK, I need to get some work done. If I'm stuck, I would just scroll through social media like it's not productive socialising."

It is notable from the above that, outside formal timetable activities, architecture students felt it was easy to acquire knowledge, inspirations, and motivations from others within the design studio learning environment. However, working online remotely disrupted that condition.

3.5 Summary: The Significance of the Design Studio Learning Environment to Architecture Students' Informal Learning between Peers

The findings from the first-phase study address the first objective "to identify if the design studio learning environment impacts on architecture students' informal learning". Specifically, it was identified in the first-phase study that the design studio learning environment enabled architecture students to engage in informal learning between peers outside their formal timetable activities. Specifically, the design studio learning environment wherever within or outside physical design studios, students can create peer-to-peer engagement between different individuals, assisting them in achieving personal acquisitions outside formal timetable activities. Since the learning stories and perceptions of the concerns regarding the learning environment transition of those nine interviewees were collected, their responses were summarised into different categories based on their common traits. For example:

- Interviewees frequently emphasised their learning within the design studio learning environment where people are present, to determine whether specific

informal learning between peers could be successfully transitioned from the physical to the virtual learning environments. Those activities were coded into the theme "creating a design studio learning environment is the primary for architecture students' informal learning between peers".

- Interviewees mentioned that they missed providing and receiving help from others, conducting teamwork, comparing work with each other, etc. when they were studying within the design studio learning environment. In addition, they could have casual chats and engage in other activities not directly related to design projects and assignments with their friends when they were studying within the design studio, to sustain their friendships and relationships with others. Those activities were coded into the theme "within the design studio learning environment where students can feel that they are not only struggling, they can generate peer-to-peer engagement with different individuals".
- Interviewees indicated that, apart from tutorials, they acquired numerous design ideas, inspirations, architectural knowledge, etc. from studying with other students beyond the formal timetable activities. Those aspects were coded into the theme "within the design studio learning environment, students get personal acquisitions from their peers to accelerate their own learning".

Accordingly, the first-phase study was conducted in a very difficult time, resulting in incomplete findings. For example, the findings derived from the first-phase study illustrate some general characteristics of informal learning experiences between peers within the design studio learning environment within and outside physical design studios. Even though, the first-phase study helps develop the theoretical framework and narrow the focus of this thesis. Specifically, this phase reveals that the theory of the community of practice can be introduced as the theoretical framework of this thesis, since these general characteristics of informal learning activities between peers meet the attributes of the community of practice, which are a shared repertoire, mutual engagement, and a joint enterprise.

- For example, one of general characteristics refers to that interviewees' informal learning activities between peers are understood and continually renegotiated based on the design studio learning environment even though their physical design studios were disabled. This characteristic can be regarded as a joint enterprise of architecture students' communities of practice.
- Another general characteristic refers to that the design studio learning environment can generate peer-to-peer engagement, which are common and also distinct between different interviewees, binding them and other students together as a unit. This characteristic can be regarded as mutual engagement of architecture students' communities of practice.
- The last general characteristics refers to that the design studio learning environment help interviewees develop their personal acquisitions, including the architectural knowledge acquired from others, the sense of learning together as a unity, creating shared learning materials, motivations from others' design projects, etc., which are all common resourced that students have developed over time. This characteristic can be regarded as a shared repertoire of architecture students' communities of practice.

Thus, whether informal learning between peers within the design studio learning environment can constitute the community of practice remains to be explored in the second phase of the study. If it works, the second-phase study will uncover specific ways and characteristics that these informal learning activities constitute the community of practice. Furthermore, the more specific ways that the design studio learning environment impacts on students informal learning experiences will be identified in the second-phase study. In a word, the second-phase study, which refers to the main study process of this thesis, should be a systematic study to ensure data saturation and comprehensiveness. The next chapter will elaborate on the methodological framework of this thesis based on the results of the first-phase study.

CHAPTER FOUR

Methodology

4.1 Introduction

Given the research gaps and results from the first-phase study, this chapter aims to identify the necessary data and appropriate measures to acquire them. This chapter outlines the ways in which collected data address the research question and four objectives. This chapter commences with the selection of appropriate methodology and data collection methods, describes the methods of data collection and data analysis, and concludes with the ethical aspects.

4.2 Developing A Methodology

4.2.1 Research Paradigm

The study subjects in this thesis are architecture students' informal learning experiences in the design studio learning environment within and outside physical design studios, so the research philosophy pertains to research different individuals' viewpoints on such learning experiences in nature. Therefore, the research paradigm for this thesis could be either interpretivism or constructivism. Specifically, Silverman (2010) indicated that interpretivists assert that different people in society interpret reality based on their own perspectives, and researchers' own viewpoints can also have impacts on the research. Thus, Burns et al. (2022) indicated that interpretivist focus on the meanings of lived experiences of phenomena. Generally, Proofed (2023) illustrated that qualitative methods and techniques are employed to conduct interpretivism research, including interviews, focus groups, observations of a phenomenon, or collecting documentation on a phenomenon (such as newspaper articles, reports, or information from websites). However, the research question of this thesis does not aim to evaluate or classify different individuals' views on informal learning experiences between peers, so interpretivism is not appropriate for this thesis. Comparatively, Silverman (2010) indicated that constructivists believe that all knowledge stems from our experiences and reflections on

those experiences, and the researcher focuses on participants' experiences as well as their own. Constructivists also believe that knowledge is acquired by learners themselves rather than educators, and the outside world can influence learning processes. Burns et al. (2022) indicated that constructivist focus on social processes and the ways participants adapting to phenomena. Aguzzoli et al. (2024) illustrated that constructivism is mostly associated with qualitative research approaches due to its emphasis on experiences and subjectivity. This thesis aims at students' learning experiences without studio tutors' instructors, based on the environment of one specific architectural institution, so constructivism is relatively more appropriate for this thesis.

Accordingly, constructivism is based on qualitative research methods, so qualitative methods were adopted as the fundamental measures to address the research question in this thesis.

4.2.2 Criteria to Address the Research Question and Objectives

Since constructivism is applied, relevant research methods should be determined to address the research question in this thesis. Regarding answering the research question, this study aims to categorise the modes of architecture students' informal learning experiences between peers within different learning environments and characteristics of such modes via the lens of the community of practice. Thus, relevant data of "what" and "how" architecture students undergo informal learning between peers would be collected, and these data should comply with the attributes of the community of practice. Moustakas (1994) indicated that, in this condition, the collected data should be theoretically saturated, universal, and over time. Therefore, the entire study process was divided into two phases. Specifically, the first phase aimed to clearly understand "what" architecture students experienced in informal learning within physical design studios and other spaces when students were outside formal timetable activities and without formal instructions and hierarchical relationships from the studio tutor. Subsequently, based on the findings from the first phase of the study, the second phase was dedicated to clearly understanding "how" those students experienced such learning through the three attributes of the community

of practice, which are a shared repertoire, mutual engagement, and a joint enterprise. This chapter introduced the reason and structure for using appropriate research methods in both phases of the study to identify the thematic modes of architecture students' informal learning experiences between peers outside formal timetable activities. Thus, the research methods and the questions designed for collecting students' relevant learning experiences need to be designed. The following four paragraphs state the criteria for question design to address the four objectives.

1. To identify if the design studio learning environment has impacts on architecture students' informal learning between peers outside timetabled teaching activities, the research methods aim to collect students' specific stories of informal learning between peers both within and outside physical design studios beyond formal timetable activities. Hence, the questions refer to asking for the perspectives of study participants on whether the design studio learning environment is important to their informal learning between their peers. If so, how does the design studio learning environment impacts their informal learning experiences?
2. To classify these modes of informal learning and to identify what characteristics they have, study participants were asked to self-assess and explain their informal learning experiences that occurred during the investigation. Hence, the questions firstly involve what informal learning between peer students mainly experience and in what learning environments those informal learning experiences take place. In addition, the questions secondarily involve why students undergo such learning within those environments. Thirdly, the questions involve how such informal learning between peers occurs.
3. To identify the ways that the communities of practice develop throughout different academic years, the informal learning experiences between peers of study participants were classified according to students' academic years.
4. To generate a model of these modes using the theoretical lens of community of practice, the prevalent informal learning activities between study participants

were assembled and classified according to attributes of the community of practice, which are a shared repertoire, mutual engagement, and a joint enterprise. Furthermore, according to common characteristics of such learning activities, a model was constructed based on three attributes of the community of practice.

4.2.3 Applying Qualitative Methods

To meet the requirements mentioned above, data collection methods should not only explore students' specific informal learning experiences but also detect the reasoning behind such experiences. Thus, the methods should achieve the following points:

1. They should assist in understanding informal learning between peers through the viewpoints and stories of students' informal learning experiences.
2. They should be flexible enough to be adjusted throughout the research process and permit the emergence of new ideas.
3. They should follow architecture students' daily routines along with their learning traits over an extended period, such as several hours to a whole day.

Accordingly, qualitative approaches were adopted as the data collection method of this study. Weiss (1994) argued that much of the crucial work that has fundamentally contributed to ourselves and our understanding of the society has been based on qualitative studies. Strauss and Corbin (2008) and Levitt et al. (2017), as cited in Mohajan (2018), all expressed that qualitative research is inductive in nature, and the researcher typically explores meanings and insights in a given situation. Dudwick et al. (2006) stated that qualitative methods refer to a range of data collection and analysis techniques that use purposive sampling to analyse long-term processes (Cross et al. 1996) and processual aspects (Bryman 1992), generating exhaustive descriptions of learning experiences with underlying patterns and context that give the information meaning. Regarding this thesis, undergraduate architecture students in one specific school were taken as the sample to collect their informal learning experiences in nature, and the research process lasts several semesters throughout the pandemic. Thus, qualitative research methods are valid for collecting data in this thesis.

4.2.4 Approach to Using Qualitative Methods

This thesis can draw inspiration from previous related literature that to understand detailed students' informal learning experiences between peers, it is feasible to apply multiple qualitative measures. Specifically, in accordance with some former research examples (such as Shaffer 2003; Ham and Schnabel 2011; Morton 2012; Budge et al. 2013; Williams 2017; Rodriguez et al. 2018; Marshalsey and Sclater 2020), researchers applied qualitative research methods to collect the experiences and perceptions of volunteered research participants', including students and project staff, on the projects or courses specifically designed for the research. For example, within those examples, the participants were required to narrate their specific learning activities (Shaffer 2003), creativity, peer learning (Budge et al. 2013), course organisation, assessment procedures and learning engagement (Marshalsey and Sclater 2020). Generally, they employed multiple data collection methods, known as data triangulation (Denzin 1989), to obtain a comprehensive perspective of students' learning experiences. For example, within the project conducted by Budge et al. (2013), the researchers developed a 'critical event' of the design course. Before this event, a focus group was conducted with all students about their views on creativity and peer learning, and then the same students were surveyed at the conclusion of the critical event with qualitative questions exploring and extending the issues the students discussed.

After all, there was a clear vision of the design for the data collection methods in the study. As shown in Figure 5, the procedure and timeline of the first and second phases of the study are presented. The two phases, as stated by Gillham (2007), can assist in verifying the data collection methods that are precise in each phase. Specifically, since it was unknown what architecture students encountered for their informal learning between peers during the pandemic, the first phase was mainly to identify the significance of the design studio learning environment to architecture students' informal learning experiences during the transition from physical to virtual learning environments; Consequently, the data collection methods and structure for the second phase were

determined by the results derived from the first phase. Hence, as stated by Oppenheim (1992), the most significant aspect of dividing into two phases is that the first phase can help the second one eliminate invalid questions, demonstrating that the targeted individuals understood the aim and meaning of those questions (Willis 2005), and conduct a preliminary analysis to avoid the issues of wording and format of questions (Bell and Waters 2018). The entire study process was conducted from October 2020 to June 2023, divided into two phases, which were initially the semi-structured interview and secondly the ethnographical methods, including observations, interviews, and focus groups.

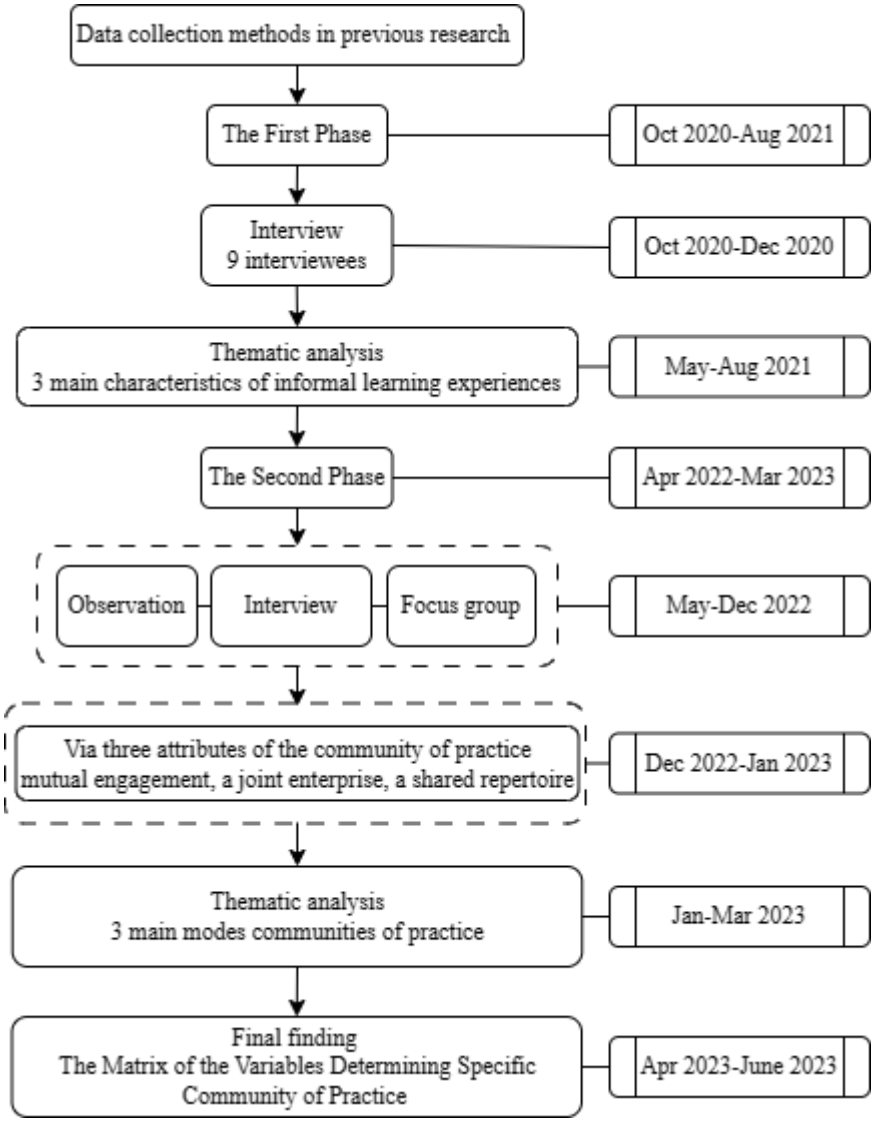

Figure 5 The Procedure and Timeline of the Study

To answer the research question and three objectives in this thesis, research methods should document the nature of architecture students' informal learning experiences

between peers in great detail and how they relate to the community of practice, and further classify those experiences into thematic modes. Thus, the expedient way to understand the modes of students' informal learning experiences between peers outside formal timetable activities is by recording some candidates' narratives of their learning experiences, known as narrative inquiry (Chase 2013). For example:

- It is a practical method to observe students' informal learning experiences in their everyday lives. Even though, as stated by Gillham (2008a), it generally cannot tell the whole story of an individual's experiences during a long and extended process, such as during the pandemic, it is valid to be used in the second phase to unearth the extensive experiences of students' informal learning between peers outside formal timetable activities. This method is also helpful in discovering some details that students themselves do not mention in the interview. Observations were also employed to collect data on the specific activities of applying the community of practice in some previous studies (such as Dillon 2013; Pressley 2015; Desikan 2009; Kakavelakis 2006).
- Asking semi-structured and open-ended questions through interviews, as indicated by Weller et al. (2018), was introduced to record students' oral and literal descriptions, describing the details of events that occurred or are occurring (Jorgensen 1989). This method not only anchors individual interviews to provide coherence (Houtkoop-Steenstra 2000) but also offers a certain degree of flexibility so that the interviewer can ask follow-up questions for interviewees to clarify or elaborate (Punch 2014), increasing the validity of the data (Maani 2019). Baker (1999) claimed that open-ended questions allowed respondents to answer in an open-text format so that they responded based on their complete knowledge, feeling, and understanding. It means that, as stated by QuestionPro (2021), the answers to these questions are not limited to a set of options. Some previous theses also applied semi-structured interviews to collect data about the community of practice (such as Brayton 2016; Reasoner 2017; Dillon 2013; Kakavelakis 2006).

From some of those previous studies, semi-structured and open-ended questions were asked by interviews to collect data from more participants in more general, which was also an approach to ensure the data saturation (Guest et al. 2006).

- Focus group, Flick (2018) articulates that, can enhance efficiency and enrich data because such groups can stimulate participants to answer questions and remember details of their experiences, enabling collected data to go beyond that from a single respondent. In another way, it is helpful to verify everyone's narratives of specific informal learning experiences between peers. Some previously related theses also took the focus group as the measure to collect data as well (such as Reasoner 2017; Pressley 2015).

The following section elaborates on the reasoning for choosing the Welsh School of Architecture and students in it as the sample and what impacts the COVID-19 pandemic brought to this study.

4.3 The Context of Research Subjects

4.3.1 The Context of Site, Pedagogy, and Impacts Brought by COVID-19 Pandemic

This section presents the context of study spaces in the school building of the Welsh School of Architecture, and some official documents and plan figures were utilised as references to have a clear visualisation of the context of the research site.

Burke (2015) indicated that the changes in studio culture arise from the implementation of the Bologna model and its three-plus-two-years (bachelor's degree plus master's degree) education pattern. The pedagogy of the Welsh School of Architecture at Cardiff University, being one of the top five architecture schools in the UK (Complete University Guide 2024; REF 2021), is a representative application of this educational pattern. Specifically, according to the introduction on this school's official website, Architecture (BSc/MArch) of the Welsh School of Architecture is a five-year architecture degree course, which comprises a three-year Part 1 Bachelor of Science, and a two-year Part 2 Master of Architecture with one year in architectural practice and a final year based in the

school. Students in each academic year can spend the majority of their time in their specific design studio, working on architectural design projects that increase in scale and complexity as students progress. Students are educated through traditional one-to-one tutorials, with the support of lectures, seminars, group assignments, and online learning materials. To ensure the above course, the school provides students with a variety of working spaces, workshops, and computer-aided design facilities to support students' learning. The school building is called "Bute Building" (hereinafter referred to as "the school building"), which was fully constructed around the 1910s, located on the west side of Cathays Park in Cardiff. Currently, it houses not only the Welsh School of Architecture but also two university libraries, which are the Bute Library and Architecture Library, which are open to all students and staff at Cardiff University, and there are two separate circulation systems within the building. Specifically, the entire second floor and some parts of the lower ground floor are open for undergraduate architecture students, ensuring a relatively isolated and independent learning environment for these students. The entire building underwent construction from 2020 to 2021, and most parts of it reopened in September 2021. Figure 6 depicts the floor plan of those study spaces within the school building, showing three design studios for all undergraduate students on three sides of the building on the same floor, but their area size and layout differ. It is also notable that the last side of the building is the tutorial space, which is marked as "Hybrid Studio" in the figure (hereinafter referred to as the tutorial space), arranged by some semi-closed study units. Generally, the tutorial space is typically used for conducting one-to-one and group tutorials, but it can also be considered as a space for other activities, such as informal learning, exhibitions, desk crits, social activities, etc. After all, undergraduate students have a relatively independent floor to engage in informal learning activities without distribution from other building users.

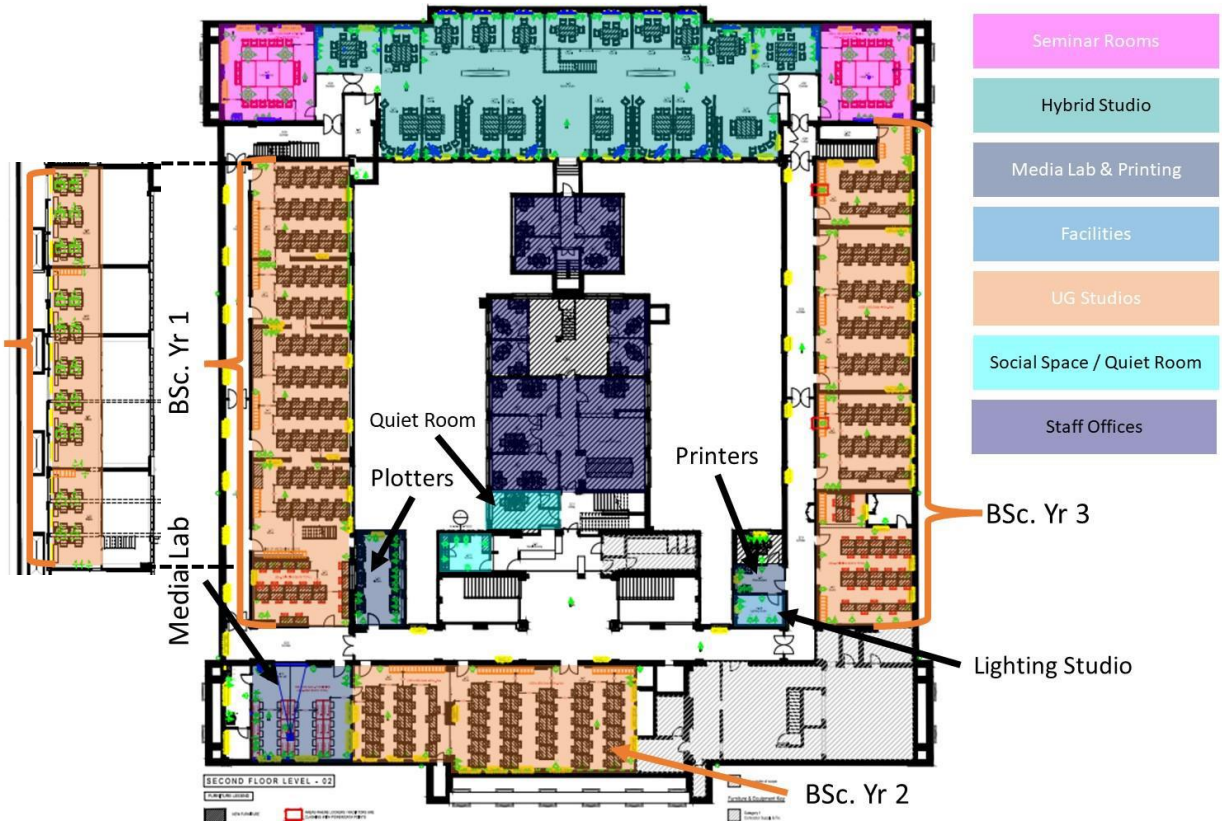

Figure 6 The Floor Plan of Design Studios and Tutorial Spaces of Undergraduate Students in the School Building (Welsh School of Architecture 2021)

To have a clear view of study participants' informal learning experiences between three academic years, this section offers readers a clear understanding of the context of design studios and other study spaces within the school building of the Welsh School of Architecture. Specifically, the physical design studios for undergraduate students are situated on the second floor of the school building of the Welsh School of Architecture, encompassing three studios for the three academic years respectively and a tutorial space for all academic years. Figure 6 presents the floor plan of the second floor and its mezzanine. In Figure 6, the 1st-year studio is located on the south side, containing a whole room and a mezzanine for self-learning spaces; the 2nd-year studio is located on the east side, possessing a relatively smaller room; the 3rd-year studio is on the north side, separated into four isolated rooms due to the undemolished walls; the tutorial space, is on the west side of the 2nd-floor of the building, composed of several semi-opened units supporting the hosting of tutorials and informal learning between peers, and there is also

a mezzanine for storing models and lightboxes. Overall, the learning environment for undergraduate students is relatively independent in the school building. They can conduct their design learning, have access to different academic years, and print their outcomes on this single floor.

It can be found from Figure 6 that physical environments differ between those design studios and the tutorial space. Specifically, the 1st-year studio, in comparison with the studios of other academic years, has a relatively more prominent space and two levels (as shown in Figure 8). Within this design studio, multiple activities, such as group interactions and individual learning, can be hosted simultaneously and separately, avoiding mutual interrupting. Although the larger studio was divided into five sections, studio users can still traverse and observe the entire studio within it, and the mezzanine is accessible within the studio, so it remains an entire space. In contrast, the 2nd-year studio is merely a simple whole space, and the area size is the smallest among all three design studios, so it often appears crowded. The 3rd-year studio is separated by entire concrete walls, making physical interactions between different learning groups relatively challenging for 3rd-year students. Regarding the tutorial space, the utilisation of this space typically depends on the structure of the week, such as desk crits and tutorials, and it is mostly for tutorials except for Wednesdays. Besides tutorials and other formal timetabled learning activities, some students (primarily 2nd- and 3rd-year) tend to undertake informal learning individually or between peers by randomly choosing a learning unit within the tutorial space due to the relatively quiet and independent learning environment. It is notable that there are two types of units within the tutorial space: tutorial units (big) and group learning ones (small), as shown in Figure 9. The environment of semi-opened learning spaces is appealing among architecture students.

Beyond design studios for undergraduate students, there are also other facilities and resources targeted at those students within the school building, which can enhance their academic learning in another valuable manner. For example, with the Welsh School of Architecture's distinctive pedagogical approach, undergraduate students can directly enter

postgraduate education upon obtaining a 2:1 degree. Postgraduate learning is divided into two phases: the first year is the working year, and the second is the studying year. Thus, many students are learning within the school in their 5th year. Figure 7 depicts the distribution of their two studios on the lower ground flower, marked as 'MA.rch 2 Studios'. Hence, they have no direct connections with current undergraduate students. Nevertheless, those students also need to attend tutorials in the tutorial space every week, so the current 3rd-year students would frequently recognise them within the tutorial space. Some 3rd-year units collaborate with 5th-year students, and they can learn from each other, but it is rare.

It is evident from the Figure 7 that 5th-year studios (marked as MA.rch 2 Studios in the figure) are closer to the school facilities, including a workshop, robotic ram, printing and plotting room, and digital lab, but there are other functions on that floor, so 5th-year studios are not isolated spaces compared with undergraduate studios. Anyway, 5th-year students had experienced learning within the studios in the school building before the pandemic. Hence, their stories are valuable references for uncovering communities of practice formed by architecture students' informal learning between peers during and outside the pandemic.

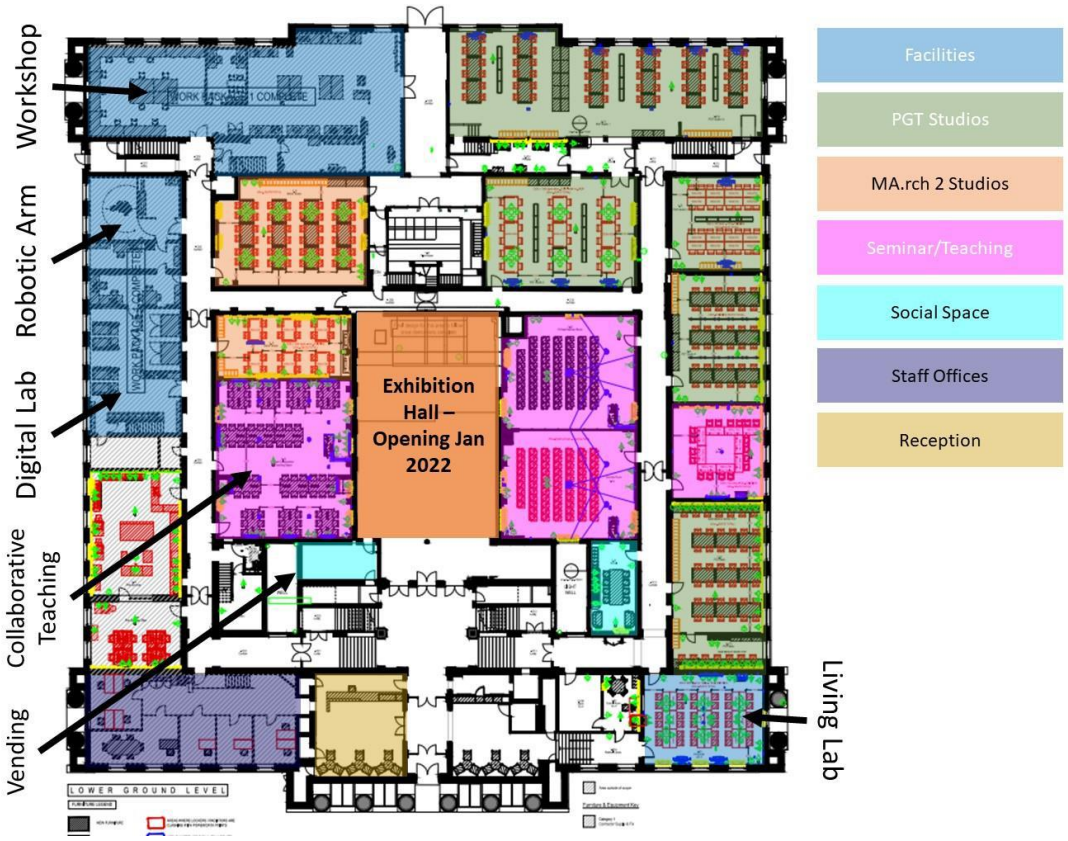

Figure 7 The Layout of the Lower Ground Floor in Bute Building (Welsh School of Architecture 2021)

After all, it is convenient for undergraduate students to spend a whole day on the second floor of the school building, except when making specific models that require the digital laboratory, robotic arm, and workshop on the lower ground floor. Therefore, even though there are numerous learning spaces within and outside the school building, many undergraduate architecture students prefer to undertake informal learning activities within their design studios to immerse themselves in the design studio learning environment, unless they have writing tasks that require searching books and a quiet environment in libraries and quiet rooms. However, it is notable that the setting layout of learning tables within physical design studios in the school building is not typical for learning architecture. Specifically, the layout of the tables is arranged in lines (as shown in Figure 10), which may only allow 2 to 8 students to sit in a 'circle' for each line. That is another reason why the tutorial space is designed for students to engage in individual and group learning outside formal timetable activities.

Figure 8 The Mezzanine of 1st-Year Studio (taken by Jierui Wang)

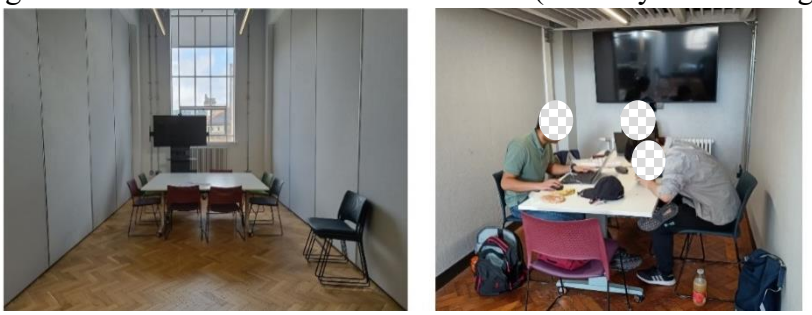

Figure 9 Big (left) and Small (right) Learning Units in the Tutorial space (taken by Jierui Wang)

Figure 10 Learning Tables Set by Lines (taken by Jierui Wang)

Besides study spaces within the school building, there are alternative spaces shared by all university students scattered across the campus of Cardiff University. For example, the campus map of Cardiff University depicts the relationship between the school building and other university facilities (as shown in Figure 11). It can be found from this figure that the school building (marked as No. 6) is surrounded by other school facilities, which can offer students some alternative study spaces. For example, some architecture students mentioned that they preferred to study within non-timetabled study places, food bars, and cafeterias within buildings marked as No. 1, No. 11, and No. 14, which are close to the school building of the Welsh School of Architecture. Accordingly, with a good reputation in architectural education, studio-based pedagogy with multiple supports, and various

study spaces within and outside the school building, the Welsh School of Architecture is representative and thus selected as the example in this thesis.

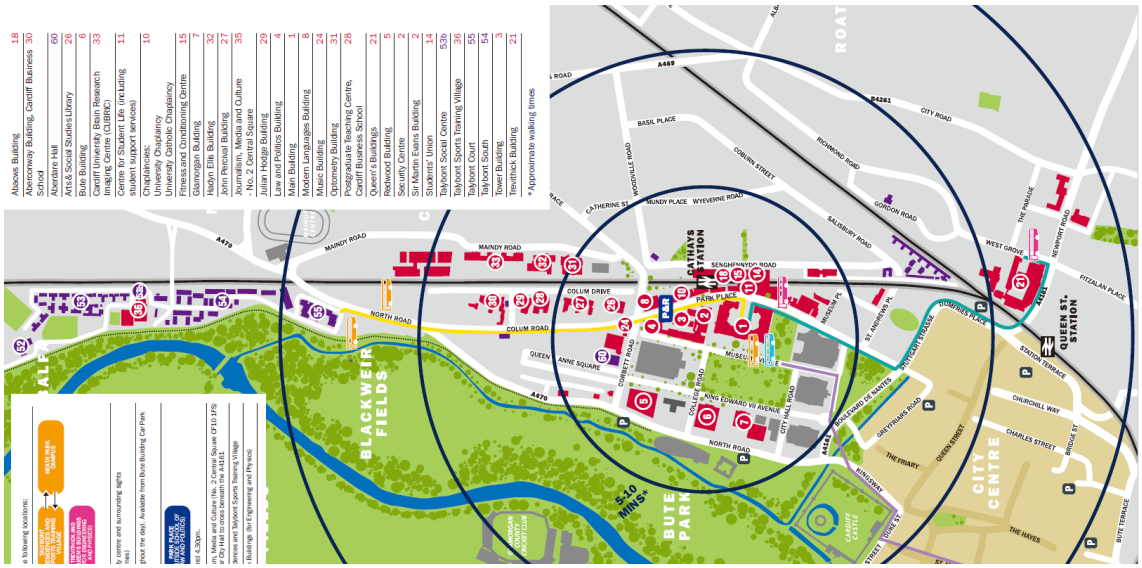

Figure 11 The Campus Map of Cardiff University (Cardiff University Undergraduate Open Day Programme Summer 2023)

However, the COVID-19 pandemic affected architecture students' physical learning, prohibiting the use of all study spaces in the university. Specifically, the pandemic began from mid-March 2020 until 2022, and the "work from home" policy to prevent the spread of the coronavirus forced students to study in their own homes and carry out their basic learning activities with the tutor and peers through virtual environments, specifically referring to Miro, Microsoft Teams, Zoom, and other social media. Hence, this situation led this thesis to conduct the first phase of the study online at the end of 2020, to collect students' viewpoints on informal learning experiences within physical design studios and virtual learning environments. Subsequently, students were permitted to study face-to-face in the conventional design studio since the beginning of 2022. Therefore, the second phase of the study was conducted in person, specifically focusing on modes and characteristics of students' informal learning experiences within physical learning environments. Specifically, except for the first phase of study conducted online, the majority of research processes of the second phase were carried out within the school

building of Welsh School of Architecture, aided by a few individual interviews and focus groups conducted in other school facilities and students' accommodations.

4.3.2 Data Sources and Instruments

As for the participants in the second phase of this thesis, the data originated from undergraduate architecture students in different academic years, representing various educational levels, and only volunteered students were selected as samples rather than the entire population. Regarding the reasoning for selecting the appropriate samples, Hancké (2009) indicated that one of the principles is that they are typical of something. In this thesis, it is crucial that the samples should be specific regarding having the daily routine of informal learning experiences within the design studio learning environment and particularly experiencing the transition from physical design studios into virtual learning environments. Thus, Table 9 illustrates the reasons for selecting students ranging from 1st- to 3rd-year students as samples.

Table 9 The Reason to Choose 1st-3rd-year Students as Samples

Academic year	Traits
1st-year	1. They had not had learning experiences within physical design studios during the academic year 2020-2021, so they were not included in cases of the first-phase study. 2. Kampen (2019) indicated that most beginner design students are not familiar with the architectural pedagogy of learning as a community. Thus, their experiences of design learning are valuable for making comparisons between 2nd- and 3rd-year students.
2nd- and 3rd-year	1. They have experienced the transition from working in the physical design studio to virtual contexts. 2. Kampen (2019) stated that they are normally capable of explaining their actions and the effects of their activities on their design tasks, and they can recognise the importance and value of working processes.

Among these students, they are selected from the academic years of 2021-2022 and 2022-2023. In summary, there were totally 200 1st-year students of 2021-2022, within which female occupied 59%, male occupied 41%, home students occupied 68%, and international ones occupied 32%. There were totally 141 2nd-year students of 2021-2022, within which female occupied 58%, male occupied 42%, home students occupied 61%, and international ones occupied 39%. There were totally 112 3rd-year students of 2021-2022, within which female occupied 60.71%, male occupied 39.29%, home students

occupied 61%, and international ones occupied 39%. There were totally 195 1st-year students of 2022-2023, within which female occupied 59%, male occupied 41%, home students occupied 79%, international ones occupied 21%. There were totally 188 2nd-year students of 2022-2023, within which female occupied 62%, male occupied 38%, home students occupied 69%, international ones occupied 31%. There were totally 143 3rd-year students of 2022-2023, within which female occupied 62%, male occupied 38%, home students occupied 58%, international ones occupied 42%. The basic information of interviewees is attached in the supportive document.

To ensure the study process, specific instruments were introduced to guarantee the efficiency and effectiveness of the study process. In addition, due to the COVID-19 pandemic and the "working from home" policy during the first phase study duration, the first-phase study was conducted online, aided by specific computer software. For example:

- Microsoft Teams was utilised for conducting online interviews.
- Microsoft Stream was employed as the instrument for editing and interpreting the recorded transcript of interviews sourced from Microsoft Teams.
- NVivo was used to analyse the qualitative data collected from the first-phase interview. This instrument was further utilised for analysing data collected from observations, interviews, and focus groups. Among different computer-assisted qualitative data analysis tools, NVivo is one of the most common tools employed in qualitative research (Muhr 1991; Richards and Richards 1991) and most social science research (Punch 2014). In addition, for saving time and enhancing the quality of analysis, Hilal and Alabri (2013) argued that NVivo is a better option to handle and yield more professional results, because, as stated by Bazeley (2007), it can assisting in organising muddled data such as transcripts into the forms of grouped themes through coding.

4.4 Second-Phase Study: Collecting How Students Experienced Informal Learning between Peers

According to findings from the first phase study, students' responses to informal learning experiences within and outside physical design studios are similar among those nine interviewees. Thus, to ensure the validity of the data collected from students, the appropriate research subjects are targeted at more undergraduate architecture students at the same institution, which was the Welsh School of Architecture, Cardiff University.

Based on findings from the first-phase study, three main themes of architecture students' informal learning experience between peers were classified. The second phase of the study aimed to recognise how those learning experiences occurred, to classify them into thematic modes via the lens of the community of practice. To adhere to data triangulation, multiple data collection methods were employed in the second phase.

The process of the second-phase study ranged from March to December 2022. Since the "work from home" policy had somewhat lost its effectiveness from the beginning of 2022, students were permitted to study from remote to face-to-face modes, so almost all of them experienced learning within both physical design studios and virtual environments, enabling research subjects to expand to students in all three academic years. Initially, the investigator conducted some trial observations (before March 2022), targeting some individual and group volunteers and elicited their informal learning experiences outside formal desk crits, sessions, and tutorials. The trial observation aimed to collect "what" and "where" students engage in informal learning between peers, to further implement the formal process with clear aims and subjects. After the trial observation, the investigator invited volunteers to participate in formal observations from March to December 2022 (excluding the summer recess).

To understand some students' underlying activities during and beyond observations, some observation participants and other individuals were invited to take interviews to supplement the data collected from the observation. Specifically, after obtaining the

consent of volunteered interviewees, they were invited to elaborate on the specific methods of their informal learning activities between peers when they were outside the formal timetable activities, to further unfold the significance of the design studio learning environment to these learning experiences. Besides, Year Chairs identified those students' responses and provided some more peripheral patterns of learning behaviours among those students. In addition, some graduated students offered essential evidence of informal learning experiences when they studied in the school building before the pandemic. The second-phase study ultimately conducted twenty-six observations, thirty-seven interviews, nine focus groups. The following sections describe these three data collection methods including observation, interview, and focus group.

4.4.1 Observation: Classifying Students' Informal Learning between Peers

Gillham (2008a) claimed that observation is the research seeking to identify practical problems individuals experienced, and it was demonstrated by some previous studies that applying observation in the first step can discover students' learning experiences more directly and clearly (such as Shaffer 2003; Rodriguez et al. 2018). The durations of informal learning between peers of participants outside formal timetable activities are diverse, usually ranging from half an hour to almost an entire day. Thus, as stated by Harding (2019), the unstructured observation should be applied, where the researcher should observe as much as possible of what participants engage in their activities to identify the informal learning experiences of volunteered students during the initial process of the second-phase study. Apart from applying observations alone, Kawulich (2005) indicated that the multi-measures can identify some points that study participants did not mention, to facilitate a better understanding of students' peer interactions. In addition, Phillippi and Lauderdale (2018) indicated that since conducting observations is an ongoing process, collecting these initial reflections can be valuable in guiding and providing suggestions for analyses of other data collection methods. Therefore, assisted with observations, some participants were also invited to take interviews and focus groups

by asking some open-ended questions, to elaborate on some informal learning activities observed and to identify participants' narratives (Gillham 2008b).

To record students' specific experiences, Gillham (2008a) indicated that the primary observation measure is observing them during their everyday lives, assisted with taking field notes of students' learning activities (Shaffer 2003). Hence, the entire process of each observation in this study was recorded by field notes, to review and compare each observation further to conduct critical analyses (Gillham 2008a). The framework of field notes is illustrated in Table 10, where the investigator could check the items that target students were experiencing and add references to mark the uncertainties and specificities. To classify each observation into specific themes, the characteristics of informal learning activities between peer students that may have an impact on classifications include "Academic Year", "Study Place", "Scale of 'Learning Clusters' Organised by Participants", "Learning Activities", and "Learning Modes". The reasoning for setting those characteristics is based on the features of observation participants and findings from the first-phase study. Specifically, students' academic years, study places, and scale of "learning clusters" organised by participants are three characteristics which can be directly distinguished. Besides them, the characteristic "Learning Activities" is classified by informal learning activities observed during observations, which are "Peer-to-Peer Supports", "Studio Environment", "Non-study related interactions", and "Personal Acquisition". The characteristic "Learning Modes", which are divided into 'Group Work', 'Peer Learning', 'Social Learning', and 'Virtual Learning', indicates four dominant types of informal learning between peers of architecture students. The original field notes are illustrated in the supportive document.

For example, "group work" indicates a project or an assignment that requires cooperation to complete, and students need to arrange a specific time and/or place to do the work together; "Peer learning" indicates a learning group that does not mandate students' cooperation, but students tend to complete the task together spontaneously; "Social learning" implies that individual students learn in an environment where people are

present, but they do not have frequent interactions with others and immerse themselves in their own work; “Virtual Learning” refers to sharing materials, contacting between students, and doing teamwork via virtual platforms, such as Miro. Figure 12 illustrates “Group Work” (left), “Peer Learning” (middle), and “Social Learning (right)”, respectively. Within the left photo, students are discussing an issue they faced in a cooperative assignment; While in the middle one, students are all dealing with the Architectural Technology project but working on their own laptops; Within the right one, students in different units are undergoing different learning modes, but they are all immersed in the design studio learning environment within physical design studios.

Figure 12 Example of “Group Work”, “Peer Learning”, and “Social Learning” (taken by Jierui Wang)

Table 10 The Framework of Observation Notes

Participant No.	1	2	3
Academic Year			
1st year 2nd year 3rd year			
Study Place			
Design Studio Tutorial Space			
Scale of "Learning Clusters" Organised by Participants			
Big (more than 8) Small (2-8)			
Learning Activities			
Peer-to-peer supports (e.g. Asking for help/Helping others) Studio Environment (e.g. Feeling motivated within the learning) environment Non-study related interactions (e.g. Socialising, such as talking about stuff not related to design work) Personal acquisition (e.g. Feeling engaged with others)			
Learning Modes			
Group Work Peer Learning Social Learning Virtual Learning			

Regarding the sampling method of observations, it is the basic requirement to ensure the data saturation (Guest et al. 2006). Thus, in this thesis, the observed learning activities consist of almost all categories of informal learning between peers of architecture students at the Welsh School of Architecture. Additionally, due to the complexity of potential data collected from the observation, Riche and Tanner (1998) indicated that breaking down observation into more minor elements makes it easier to control and change. This process is named multistage sampling, as indicated by Mirakhmedov et al. (2015), that the selection of samples is divided into multiple stages using smaller and smaller subgroups. For example, Fawcett (1996) suggested three sampling measures according to event, activity, and time of behaviours. Therefore, in this thesis, observations are classified based on three stages, including the academic years of students, the places where learning activities occur, and characteristics and habitus of students' informal learning activities

between peers. To classify these observations, they were numbered according to three stages identified by obvious characteristics of participants' informal learning between peers, and furthermore, specific field notes were generated. Specifically, different academic years were coded as the first stage, indicating 1, 2, and 3; Different study places were coded as the second stage, indicating 1.1 and 1.2, etc.; Different learning activities were clustered into the third stage, indicating 1.1.1, 1.1.2, 2.1.1, 2.1.2, 3.1.1, 3.1.2, etc. For example, some first-year students do their own learning and other tasks in the form of a group with 2-3 members within their studio, and this phenomenon can be symbolised in '1.1.3'; Likewise, 2nd-year students sometimes communicate with study fellows within the tutorial space, and this can be coded as '2.2.1'; In addition, some 1st-year or 2nd-year students ask for help to seniors privately, and this can be symbolised as '1.2.1' or '2.2.1'. In summary, by the end of December 2022, there have been twenty-six observations, including four for 1st-year, nine for 2nd-year, twelve for 3rd-year, and one for 5th-year. The basic information of observations and their participants is illustrated in the supportive document. Accordingly, the specific structure of the observations and field notes is illustrated in In addition, to avoid some unexpected and peripheral conditions or scenarios that the investigator could not recognise during the process of each observation, some participants were asked to take interviews and/or focus groups, answering some structured and semi-structured questions, to clarify during and after the observation (Frankfort-Nachmias and Nachmias 2008) but ensuring that their normal behaviours were not influenced (e.g. wearing headphones to listen to music).

Table 11 as shown below.

In addition, to avoid some unexpected and peripheral conditions or scenarios that the investigator could not recognise during the process of each observation, some participants were asked to take interviews and/or focus groups, answering some structured and semi-structured questions, to clarify during and after the observation (Frankfort-Nachmias and Nachmias 2008) but ensuring that their normal behaviours were not influenced (e.g. wearing headphones to listen to music).

Table 11 The Structure of Observation Field Notes

1st stage	2nd stage	3rd stage	Code
1st-year 2nd-year 3rd-year	Design Studio Tutorial Space	Help each other or being helped, compare work, working together	1.1.1 / 2.1.1 / 3.1.1 1.2.1 / 2.2.1 / 3.2.1
		Be motivated by being in the studio, such as to work harder	1.1.2 / 2.1.2 / 3.1.2 1.2.2 / 2.2.2 / 3.2.2
		Socialising, just like talking about things not directly related to the project and design studio learning environment, etc.	1.1.3 / 2.1.3 / 3.1.3 1.2.3 / 2.2.3 / 3.2.3
		Feel more engaged with other members who learn within the design studio learning environment	1.1.4 / 2.1.4 / 3.1.4 1.2.4 / 2.2.4 / 3.2.4

The duration of observation depends on the duration of activities observed. For example, architecture students typically undergo informal learning between peers lasting several hours, even a whole day outside formal timetable activities, so the observation will follow the entire learning process. Hence, the observation applied in this thesis follows a time-sampling schedule (Frankfort-Nachmias and Nachmias 2008) to determine the timing of observation. Fawcett (1996) indicated that the results of observations are presented in the form of charts, codes, or symbols rather than narrative accounts to achieve 'theoretically neutral observation language' (Hughes 1980). Combined with the majority of undergraduate architecture students' learning habitats, the observations usually occurred from those students' lunchtime to late afternoons, divided into two to three separate periods, which lasted at least half an hour to several hours.

4.4.2 Interview and Focus Group: Extension to Observations

Besides interviews and focus groups after each observation, there were also some interviews and focus groups targeting more students apart from observation participants. Regarding the measures of seeking participants of those interviews and focus groups, the author directly invited students from the student list which was provided by supervisors and Year Chairs, and they assisted in searching for participants; Another measure was inviting students who were studying within physical design studios and other non-timetabled learning spaces outside the formal timetable activities, determined by their informal learning activities; Besides onsite measures, online ones were also utilised. Specifically, the author initially obtained the contact information of students throughout

all academic years from relevant staff and then sent them the invitation emails with the aim of the study and consent information. Organising students in different focus groups was achieved by directly inviting students who were studying in groups and asking interviewees to invite their peers to participate as a group.

According to students' prevalent responses to physical and virtual learning experiences in the first-phase study, it was known that the design studio learning environment, peer-to-peer engagements between students, and personal acquisition are three significant elements when students are engaged in informal learning between peers, so the semi-structured and open-ended questions for the second-phase study are categorised into three themes based on these three elements. The first theme is collecting prevalent students' informal learning experiences between peers and the ways that they engage in informal learning within and outside design studios; The second theme is getting to know the significance of the design studio learning environment to students' informal learning between peers, to explore the specific ways of undertaking such learning activities within physical design studios and other non-timetabled learning spaces; The last one is asking for students' perceptions on the personal acquisitions from these informal learning experiences and reasons to maintain them. The specific questions of the first theme are articulated below:

1. Do you usually study with your fellows outside formal desk crits, sessions, and tutorials (including talking about design ideas of the design project, sharing learning materials outside formal teaching sessions, asking for help from others about unknow knowledge, or even doing your own stuff with others' company, etc.)? Please elaborate on a specific example of what you typically do within those learning processes (including helping others by asking for help, group work, and working by yourself with fellows around).
2. How do you achieve such learning processes? When do you organise them? Where do those learning processes happen (design studio/hybrid studio/other places or even online)? How long does each process last on average?

The question of the second theme is:

1. Does the design studio learning environment within the physical design studio facilitate those learning processes? What are the differences between doing them within and outside the physical design studio?
2. What factors can affect your choice of learning places, such as learning culture, learning environment, living cost, commuting time, etc.?

The questions of the third theme are:

1. How do those learning processes help you grasp architectural knowledge?
2. How do you monitor how well you have progressed after those learning processes?
3. What reasons enable you to study with your fellows? What reason enable you to study on your own?

Regarding the sampling method of interviews, it is the basic requirement to ensure the data saturation (Guest et al. 2006). Thus, in this thesis, the learning activities of interviewees consist of almost all categories of informal learning between peers of architecture students at the Welsh School of Architecture. As for the categorisation of different interviewees, to distinguish them from interviewees in the first-phase study, they were numbered into Student A, B, C, D, E…, and then there were also sub-groups divided by students' academic years, which were Year 1, Year 2, Year 3, and Graduated for those students who were in Part-2 stage. In summary, by the end of December 2022, there have been thirty-nine individual interviews, including ten 1st-year students (six within the 1st-year design studio, one within the tutorial space, one within the student accommodation, two remotely), twelve 2nd-year students (eleven within the studio and one outside the school), thirteen 3rd-year students (seven within physical design studios, one outside physical design studios, five within the tutorial space), two 5th-year student (one within the 5th-year studio, another remotely), and two Year Chairs. The basic information of interviews and interviewees is illustrated in the supportive document.

Frankfort-Nachmias and Nachmias (2008) claimed that individuals only reporting their behaviours verbally, however, may not validly capture informal learning activities

between peers, as they require subjects to post-rationalise their experiences rather than capture subjects in action. Particularly in architecture, a practice-based discipline, as stated by Kampen (2019), students' learning activities originate from their intuition and tacit knowledge, so they may have no sense of past learning experiences, which was demonstrated in the first-phase study. One valid way to avoid the issues above is to collect data via focus group, which was first pointed out by Merton and Kendall (1946). Gillham (2005) indicated that focus group is mostly used in two conditions: one focuses on a highly defined topic discussion, and the other aims for a specifically defined group of individuals. This study describes the topic as "experiences of informal learning occurred between peers within and outside physical design studios", and the individuals are defined as "students who learn in the same design studio or unit". The most important, as stated by Reasoner (2017), is that the participants of each focus group can be regarded as a community of practice, so that it is easy to compare with the learning patterns of each community of practice. Nevertheless, the major methodological issue caused by the focus group is "group thinking". To minimise that issue, there would be some pre-interview aimed at individuals before conducting the focus group to collect empirical thinking and perspectives, such as the most popular spaces of undergraduate students' informal learning between peers.

Thus, besides individual interviews, several students were asked questions in the form of focus groups, to provide more details of learning experiences, and to ensure the mutual confirmation between different individuals. Each focus group was sampled depending on the genres of students' informal learning activities between peers. Specifically, as the sample method applied in the observation, focus groups were classified according to three stages identified by obvious characteristics of participants' informal learning between peers. Specifically, different academic years were coded as the first stage, indicating 1, 2, and 3; Different study places were coded as the second stage, indicating 1.1, 2.1, etc.; Different learning activities were clustered into the third stage, indicating 1.1.1, 1.1.2, 2.1.1, 2.1.2, 3.1.1, 3.1.2, etc. Furthermore, to determine the sample size of focus groups,

apart from the data saturation (Guest et al. 2006), Barbour (2007) suggested that focus groups with many attendants are not suitable to elicit individuals' narratives, and several groups (Ong 2003) with smaller size of each group (Côté-Arsenault and Morrison-Beedy 1999) are more likely to collect the detailed picture of individuals' experiences. Additionally, Patton (2015) indicated that focus groups typically consist of 6 to 8 people for one-half to two hours. Different from that, Rodriguez et al. (2018) argued that the focus group aims to organise three to twenty groups with two to four students each, often learning together or working in a group. Comparatively, in this study, focus groups are typically on a small scale, consisting of two-four students who were learning as a settled group.

As for the duration of each focus group, Kuhn (2018) indicated that it is possible to arrange a short focus group within 60 minutes to host several sessions in the same timeframe. Therefore, the duration of each focus group in this thesis can vary but should be effectively controlled within the recommended period to prevent the discussions among students from taking up too much time.

Table 12 illustrates the hierarchical relationship between multistage samplings. It is notable that the second stage of the focus group has one more option, "other places", compared to that of the observation. "Other places" indicates where students do informal learning between peers outside their design studios and the tutorial space, such as public spaces in their accommodations, learning spaces in other university facilities, cafeterias, etc. In summary, by the end of December 2022, there have been eight focus groups, consisted of one for 1st-year students, three for 2nd-year students, four for 3rd-year students. The basic informal of focus groups and their participants is illustrated in the supportive document.

Furthermore, to determine the sample size of focus groups, apart from the data saturation (Guest et al. 2006), Barbour (2007) suggested that focus groups with many attendants are not suitable to elicit individuals' narratives, and several groups (Ong 2003) with smaller size of each group (Côté-Arsenault and Morrison-Beedy 1999) are more likely to collect the detailed picture of individuals' experiences. Additionally, Patton (2015) indicated that focus groups typically consist of 6 to 8 people for one-half to two hours. Different from that, Rodriguez et al. (2018) argued that the focus group aims to organise three to twenty groups with two to four students each, often learning together or working in a group. Comparatively, in this study, focus groups are typically on a small scale, consisting of two-four students who were learning as a settled group.

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Table 12 The Framework of Focus Groups Sampling

1st Stage	2nd Stage	3rd -Stage	Codes
1st-year 2nd-year 3rd-year	Design Studio Tutorial Space Other Places	Help each other or being helped, compare work, working together	1.1.1/2.1.1/3.1.1/1.2.1 /2.2.1/3.2.1/3.1.1/3.2. 1/3.3.1
		Be motivated by being in the studio, such as to work harder	1.1.2/2.1.2/3.1.2/1.2.2 /2.2.2/3.2.2/3.1.2/3.2. 2/3.3.2
		Socialising, just like talking about things not directly related to the project and design studio learning environment, etc.	1.1.3/2.1.3/3.1.3/1.2.3 /2.2.3/3.2.3/3.1.3/3.2. 3/3.3.3
		Feel more engaged with other members who learn within the design studio learning environment	1.1.4/2.1.4/3.1.4/1.2.4 /2.2.4/3.2.4/3.1.4/3.2. 4/3.3.4

4.4.3 Data Analysis: Classifying Thematic Modes of Students' Informal Learning Experiences between Peers

The "raw data" collected from students, as stated by Coffey and Atkinson (1996), were transformed into literal versions that can be easily analysed. As this research topic is to identify a small-scale exploratory study which requires an inductive approach to analyse data, such as thematic analysis (Jamieson 2017, Harding 2019) and category coding to identify similarities and differences between the accounts (Harding 2019). Denzin and Lincoln (1998) claimed that the thematic analysis is a foundational inductive approach which aims to convert the results of interactions between the researcher and data into items that are easy to analyse. Likewise, Riley (1996) indicated that the actions of thematic analysis are divided into the specific order from coding data to summarising specific themes, which is an inductive process. Anyways, to categorise and identify different themes, qualitative coding is necessary. Specifically, Silver and Lewis (2014) indicated that coding is the process by which segments of data are identified as relating to, or being an example of, a more general theme; Silver and Lewis (2014) also emphasised that it is essential to link different segments or instances within the whole dataset to a particular idea or concept; so, as indicated by Williamson et al. (2018), the codes frequently refers to "data categories" which means that researchers split data categories into sub-categories that are easy to be analysed and retrieved at a later stage. Based on the characteristics of this analysis technique, Coffey and Atkinson (1996) argued that many qualitative data analyses are identified by critical themes initially, and

these processes are determined by coding data. For instance, the field notes taken by Shaffer (2003) were coded into different themes based on issues that emerged from interviewees' activities and their explanations of activities within the virtual studio. Likewise, within the previous research conducted by Pektaş (2015), participants' responses were analysed by an established phenomenological procedure (Yang and Tsai 2010), identifying emerging themes and then discussing with participants to reach a consensus, followed by an iterative process of discussing and refining the thematic categories to get a total agreement. In addition, Budge et al. (2013) applied a comparative thematic approach to analyse data of design students' creativity and peer learning within studio-based education, which were collected from three different qualitative methods in nature.

Accordingly, my thesis ultimately applied the procedure of the thematic analysis pointed out by Braun and Clarke (2006), to identify general data into specifically organised themes and further model the coding framework (Barbour 2007). A little bit different from a totally inductive process, my thesis initially added a step to ensure that all data are sourced from the attributes of the community of practice, which refers to a deductive process. Specifically, these attributes, referring to a shared repertoire, mutual engagement, and a joint enterprise, were set as the high-level themes, in further to classify these informal learning activities as sub-themes. For example, the researcher matched transcripts of interviews and focus groups with the elements of mutual engagement, including doing things together, social complexity, community, maintenance, and engaged diversity. In addition, the elements of a joint enterprise and a shared repertoire were also matched with field notes of observations and transcripts of interviews and focus groups. Furthermore, the next-step specific thematic analysis method and procedure pointed out by Braun and Clarke (2006), as illustrated in Table 13, were applied as a inductive analysis step in this thesis, to summary the ways that architecture students' informal learning between peers constitutes the community of practice.

Table 13 The Process of the Thematic Analysis in This Thesis

Phase	Description of the process	What actually did in my thesis
Setting high-level themes	Before assembling and classifying data, making some concepts as high-level themes, and then searching for original data to match them.	Setting three attributes of the community of practice as the high-level themes
Familiarising with the data	Transcribing data, reading, and rereading the data, noting down initial ideas	Taking field notes from observations and transcripts from interviews and focus groups
Generating intimal codes	Coding interesting features of the data across the entire data set, collating data relevant to each other	Separating data from observations and those from interviews and focus groups as two separated datasets
Searching for themes	Collating codes into potential themes, gathering all data relevant to each potential theme	Assembling all initial codes from two separated datasets, respectively, and then summarising specific themes
Reviewing themes	Checking the themes work in relation to the coded extracts and the entire dataset, generating a thematic map	Comparing themes from two separated datasets, drawing common traits
Defining and naming themes	Ongoing analysis for refining the specifics of each theme and the overall story that the analysis to the research question and literature, producing a report of the analysis	Defining and naming each theme according to the research question and objectives

The step-by-step analysis process is articulated below:

1. Set three attributes of the community of practice, referring to a shared repertoire, mutual engagement, and a joint enterprise (Wenger 1998) as the high-level themes. Subdivide these attributes by their characteristics and match them with field notes of observations and transcript of interviews and focus groups. The characteristics of each attribute are known from Wenger's statement as indicated in Section 2.2.2.
2. Familiarising with the data: Taking field notes of observations and transcripts of study participants' interviews and focus groups, describing participants' informal learning experiences between peers according to those experiences' specific and mutual characteristics.
3. Generating intimal codes: In light of field notes collected from observations and transcripts interpreted from focus groups and interviews, respectively, students' informal learning experiences between peers outside formal sessions, tutorials, and desk crits were coded into specific themes according to these two datasets separately. The coding process is illustrated at the end of this section.

4. Searching for themes: To classify those learning experiences into specific modes, the data were coded according to these two separated datasets, respectively. Subsequently, common traits of codes were summarised into specific themes.
5. Reviewing themes: the entire group of study participants were reviewed to ensure that their informal learning activities between peers were classified based on themes. Subsequently, a thematic map that consists of quotations, key-wards, original coding, initial themes was generated.
6. Defining and naming themes: As for interpreting notes of observation to valuable data, this study applies the 'thick description[2]' (Geertz 1973). For example, within the experiment conducted by Shaffer (2003), field and interview notes were analysed using case-focused analysis (Weiss 1994), and such analyses were set to find out phenomena by gathering a rich set of data for a limited number of instances to create a "thick description", in which specific experience examples can be described to illustrate how participants understand and organise their activities. In this thesis, students' learning activities and experiences were structured by different genres of the phenomenon and coded into different symbols. The reason to digitise the field notes, as stated by Phillippi and Lauderdale (2018), is that they can be searched by keywords and recognised by topic, time, or participants.

Figure 13 illustrates an example of the coding process. Specifically, mutual engagement is initially set as the high-level theme. Followed by that, one characteristic of mutual engagement, which is "doing things together", is set as the sub-level theme and given the explanation. Subsequently, some interviewees' accounts are selected to match "doing things together", and then code these statements into a theme according to their common

[2] The thick description refers to a detailed description of actual behaviour, typically resulting from ethnography (Geertz 1973). As stated by Leeds-Hurwitz (2015), a thick description is sufficient to describe below-surface appearances by offering an understanding of underlying patterns and context that give the information meaning.

traits. For example, “doing things together” is interpreted into “students engage in learning and other activities with others”. Followed by that, three students’ accounts regarding cooperating as the form of small-scale learning groups in different spaces were selected to match this sub-level theme.

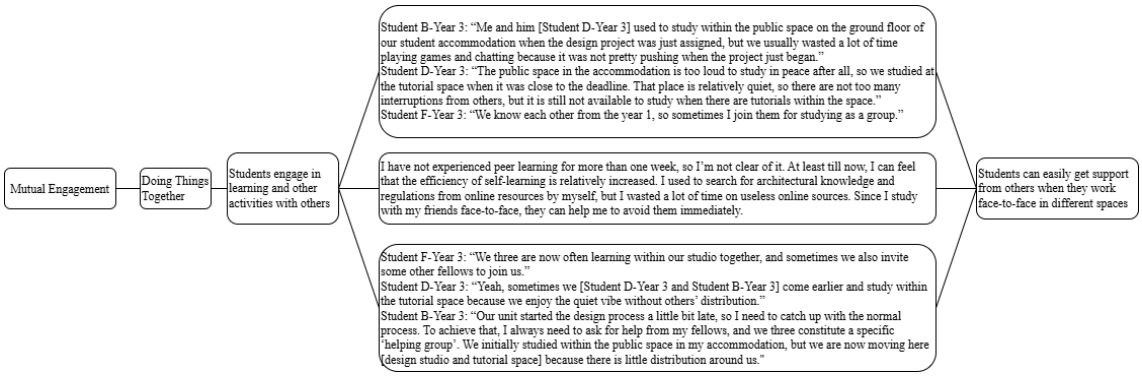

Figure 13 An Example of the Coding Process

4.5 Ethical Aspects

The consideration of ethical aspects is crucial for a study, and these can arise during any phase of the research process, such as selecting participants, collecting, and analysing data, and reporting findings (Bloomberg and Volpe 2018; Maxwell 2013). It is vital that ethical issues are considered in the research, particularly when human subjects are involved (Punch 2014). Even though the first-phase study aimed at a small scale of students, ethical aspects must be considered during the study process. According to the ethical requirements, before conducting interviews and focus groups, all the questions that need to be asked are in accordance with the ethics policies of Cardiff University. For example, during the first-phase study, interviewees were first informed of the basic information of the study and the data which would be collected, and participants in all data collection exercises were given the opportunity to withdraw from the research at any time. The first-phase study's Ethics Approval Form is attached in the Appendix.

The same as the process of the first-phase study, since students were involved in the entire process of the second-phase study, ethical issues should be noted at all times. For example, according to the ethics policy for human research of Cardiff University, participants should be fully informed of the purpose of the project; Confidentiality should be

guaranteed during the research process; Participants need to be allowed to withdraw at any time; The last but not the least is obtaining participants' consent to participate in the study before collecting data. Obeying such requirements, before conducting interviews, focus groups, and observations during the second-phase study, all the questions that need to be asked to follow the ethics policies of Cardiff University, and the Ethics Approval Form is attached in the Appendix. Participants in all data collection exercises can withdraw from the research at any time. Before implementing observations, interviews, and focus groups, the documents containing the requirements of the study, including consent information, are informed to volunteered students. By explaining the research objectives and being ethically appropriate, the participants fully understand their roles and responsibilities for the study. Besides, to implement observation, the investigator needs to acquire the provision of participants to observe and record within physical design studios and get approval for recording students' learning beyond formal timetable activities. The data collection process can be conducted only if the consent is approved.

4.6 Summary

Based on the research question to address and research gaps to fill, this chapter describes the methodology framework, demonstrating comparatively relatively reasonable measures to collect and analyse data in this thesis. Specifically, this chapter states the aim, procedure, methods, and analyses of the two phases of this study. The data came from the first-phase study, which is a trial interview (n=9). According to the thematic analysis results, the design of the structure and question for the second-phase study was confirmed. Those methods in the second phase tend to record students' stories of informal learning between peers when they are outside formal timetable activities, and multiple data collection measures were applied in the second phase, which were observations, interviews, and focus groups. After data collection, the interpreted data are analysed by means of specific data-analyse measures. In terms of the specific findings, the following two chapters will elaborate on the thematic analysis and academic year-based results, respectively.

There are still some limitations of this methodology. For example, students in only one architectural school were selected as the sample, so it lacks generality. In addition, this methodology is qualitative methods only, lacking objectivity. Besides, the timing of conducting the research is limited. It is also notable that the most obvious practical concern of the method this study uses is that long-term studies require participants' sense of responsibility and dedication. To ensure that the students participate in the study as much as possible, the Year Chair of each academic year assisted in forwarding the invitation email of individual interviews, focus groups, and observations to the students.

CHAPTER FIVE

The Thematic Characteristics of Architecture Students' Informal Learning between Peers

5.1 Introduction

Chapter 3 presented the findings from the first-phase study, demonstrating three general characteristics of architecture students' informal learning between peers both within and outside physical design studios. However, the manner in which these informal learning activities between peers constitute the community of practice have not yet been analysed based on specific characteristics. Hence, this chapter summarises the modes and characteristics of architecture students' informal learning between peers, via the lens of the community of practice.

This chapter elaborates the fundamental findings from the second-phase study, identifying three thematic characteristics of architecture students' informal learning between peers according to three attributes of the community of practice. Consequently, the titles of the following three sections are integrated by these three thematic categories: a shared repertoire, mutual engagement, a joint enterprise of. This chapter concludes with a summary of the ways that students' informal learning between peers constitute communities of practice, and the contents answer the first and the second research objectives.

As data were collected from two main methods, which are observations as well as interviews and focus groups, the findings were also analysed separately. As indicated in Section 4.4.3, thematic analysis was applied to analyse collected data, and three attributes of the community of practice were set as the high-level themes. The themes from separated datasets have overlap parts, which indicates that data collected from different methods are relevant and consistent. The specific coding processes of these two datasets are elaborated on in the following three sections.

5.2 A Shared Repertoire

According to Wenger's (1998) statement, a shared repertoire refers to communal resources that community members have developed over time, containing mutual stories, styles, tools, actions, historical events, concepts, etc. The definition of these communal resources is interpreted by the voice of architecture students' informal learning between peers in the coding system of this thesis, as indicated in the following two sections.

5.2.1 Findings from Observations

All observations were taken on campus only, so the data collected from observations only manifest limited information of all types of informal learning activities between peers. For example, **Error! Reference source not found.** illustrates data collected from observations regarding a shared repertoire. Within all data collected from observations, six field notes are selected to match two characteristics of a shared repertoire, which are "Actions" and "Tools". Specifically, "Actions" regarding informal learning between peers in this thesis refers to some specific informal learning activities that students are used to do outside their formal timetable activities. "Tools" regarding informal learning between peers in this thesis refers to some specific learning materials and learning-supportive facilities, which assist students' informal learning activities between peers. It is noticeable that the cubes within the hatch Green rectangle on the right side of the coding diagram depicts an inductive process. Specifically, the collected data are firstly classified according to their common characteristics, and such characteristics are further coded into specific themes, which are ultimately coded into the final theme. Accordingly, all themes indicate that study participants generally constitute two forms of informal learning between peers, which are "learning group" in a small scale and "learning community" in a large scale. Nevertheless, it was unknown from observations that if there are other forms of these informal learning activities, since students may constitute a design studio learning environment and organise informal learning groups in other spaces off campus. The related data regarding these two characteristics are elaborated below.

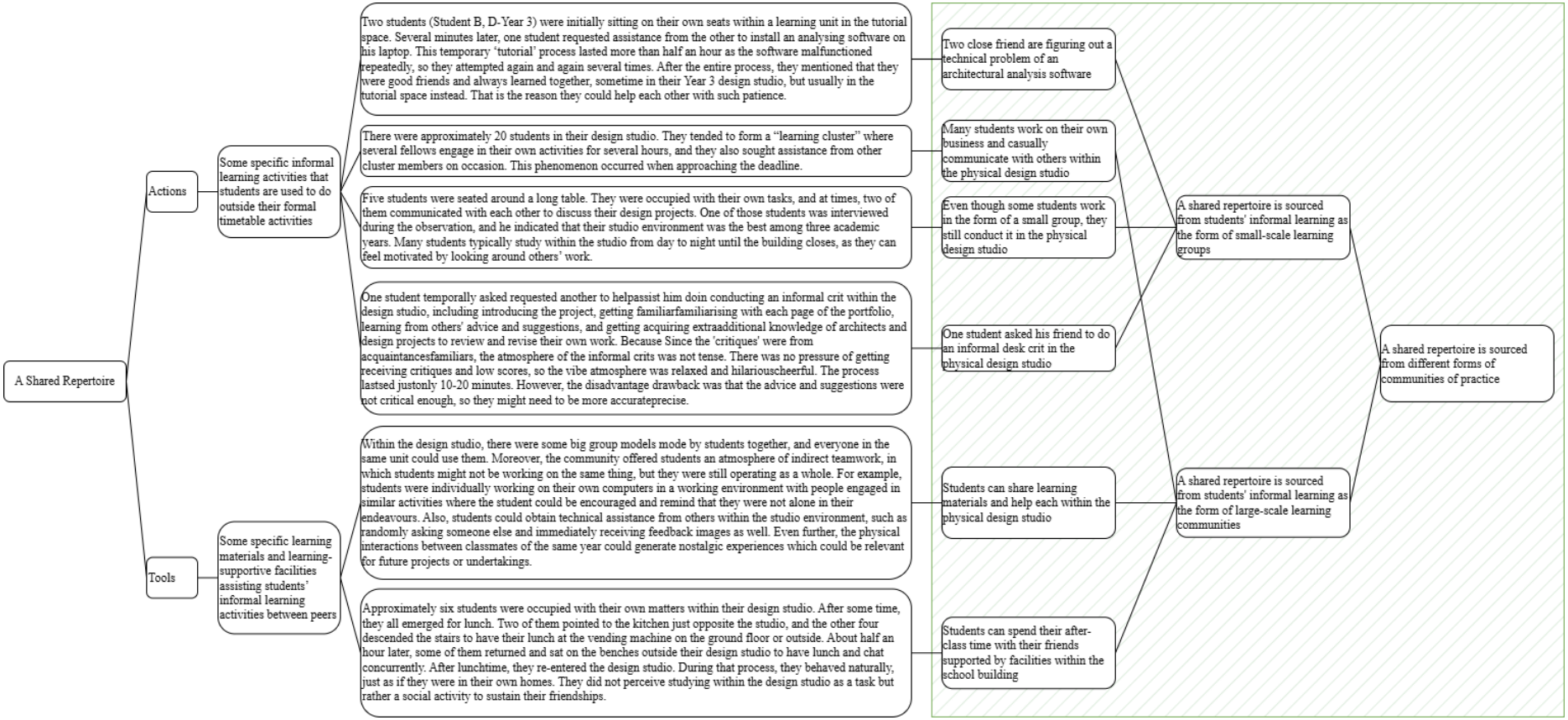

Figure 14 The Thematic Map of A Shared Repertoire Collected from Observations

Under the theme of "Actions", it was observed that study participants typically engaged in informal learning between peers as distinct forms of "learning clusters" within physical design studios, and there exists no fixed pattern of these learning clusters. For example, within these learning clusters, many of them are organised by specific members, who typically organise the form of several "learning groups". Specifically, these learning groups are organised by a small group of students (normally 2-8), who are generally friends or specific study companions, existing for a prolonged period or even throughout the entire semester. These group members typically engage in their own learning activities or other tasks, and they casually communicate with others during their learning processes. The example below presents a typical instance of learning groups (as shown in Figure 15). Field Notes 3.2.1, 15.00-16.00 11th May, Wednesday 2022:

> Two students (Student B, D-Year 3) were initially sitting on their own seats within a learning unit in the tutorial space. Several minutes later, one student requested assistance from the other to install an analysing software on his laptop. This temporary 'tutorial' process lasted more than half an hour as the software malfunctioned repeatedly, so they attempted again and again several times. After the entire process, they mentioned that they were good friends and always learned together, sometime in their Year 3 design studio, but usually in the tutorial space instead. That is the reason they could help each other with such patience.

Figure 15 Two "Close Friends" Are Resolving a Key Technical Problem of a Software (taken by Jierui Wang)

By contrast, some students tend to engage in informal learning activities with many others as the form of a "learning community", within which students mainly work on their own tasks as well, and one learning community is constituted by several learning groups and individuals. A learning community usually takes place within physical design studios,

existing for a short duration, especially close to the deadline for submitting the final work. Specifically, it was found from observations that, every week, even though there is no session and tutorial on Wednesday afternoons, approximately 15 percent of students studied in the form of an entire community within their design studios. It was notable that these students could casually acquire the necessary architectural knowledge and skills from the learning community, and the community enhanced students' sense of collaborative learning. For example, as shown in the Field Notes 2.1.1-1, 12.30-15.30, 15th May, Sunday 2022:

> There were approximately 20 students in their design studio. They tended to form a "learning cluster" where several fellows engage in their own activities for several hours, and they also sought assistance from other cluster members on occasion. This phenomenon occurred when approaching the deadline.

It was also observed that study participants tended to communicate with others who are familiar with. For example, some students could easily get help from their friends, and this method could genuinely inspire their design thinking and further develop their project. For example, one student asked his friend to do a trial crit before the formal desk crit, as shown in Field Notes 2.1.1-2, 12.30-13.30 12th May, Thursday 2022:

> One student temporally requested another to assist him in conducting an informal crit within the design studio, including introducing the project, familiarising with each page of the portfolio, learning from others' advice and suggestions, and acquiring additional knowledge of architects and design projects to review and revise their own work. Since the 'critiques' were from acquaintances, the atmosphere of the informal crits was not tense. There was no pressure of receiving critiques and low scores, so the atmosphere was relaxed and cheerful. The process lasted only 10-20 minutes. However, the drawback was that the advice and suggestions were not critical enough, so they might need to be more precise.

Thus, within the design studio learning environment in physical design studios, students not only can individually immerse in the large-scale learning community, but they can also study as the form of several small-scale learning groups. For example, one learning community could be typically constituted by several learning groups, within which students engaged in specific informal learning activities and other tasks, and each learning

group also has engagement with others, as shown in Field Notes 2.1.2, 13.30-14.00, 4th May, Wednesday 2022:

> Five students were seated around a long table. They were occupied with their own tasks, and at times, two of them communicated with each other to discuss their design projects. One of those students was interviewed during the observation, and he indicated that their design studio learning environment was the best among three academic years. Many students typically study within the studio from day to night until the building closes, as they can feel motivated by looking around others' work.

Under the theme of "Tools", it was observed that students could make and share their learning materials, such as physical modals, pin-ups, and drawings, with others within the design studio learning environment in physical design studios. For example, as shown in Field Notes 2.1.4, 13.00-15.00, 10th May, Tuesday 2022:

> Within the design studio, there were some big group models mode by students together, and everyone in the same unit could use them. Moreover, the community offered students an atmosphere of indirect teamwork, in which students might not be working on the same thing, but they were still operating as a whole. For example, students were individually working on their own computers in a working environment with people engaged in similar activities where the student could be encouraged and remind that they were not alone in their endeavours. Also, students could obtain technical assistance from others within the design studio learning environment, such as randomly asking someone else and immediately receiving feedback images as well. Even further, the physical interactions between classmates of the same year could generate nostalgic experiences which could be relevant for future projects or undertakings.

Besides learning materials shared between students in physical design studios, some external factors outside physical design studios also exert an influence on the organisation of communities of practice. Specifically, the living- and learning-support facilities, which were engaged in the school building, such as kitchen, benches, media lab, plotter room, printer room, library, etc. enabled students to spend very long time within physical design studios. For example, as shown in Field Notes 2.1.3-1, 13.00-13.45, 21st May, Saturday 2022:

> Approximately six students were occupied with their own matters within their design studio. After some time, they all emerged for lunch. Two of them

> pointed to the kitchen just opposite the studio, and the other four descended the stairs to have their lunch at the vending machine on the ground floor or outside. About half an hour later, some of them returned and sat on the benches outside their design studio to have lunch and chat concurrently. After lunchtime, they re-entered the design studio. During that process, they behaved naturally, just as if they were in their own homes. They did not perceive studying within the design studio as a task but rather a social activity to sustain their friendships.

Observations above depict that study participants typically organise two forms of communities of practice, which are small-scale learning groups and large-scale learning communities, within the design studio learning environment in physical design studios and tutorial spaces. This design studio learning environment ensures study participants to not only engage in their own learning activities and other non-study related tasks but also ask for help from others and learning materials within the design studio learning environment. Within these two forms of communities of practice, study participants generally also have different forms of a shared repertoire. Specifically, within small-scale learning groups, group members are typically friends or specific study companions, they usually engage in their own learning activities and non-study related tasks, and they also occasionally share their knowledge with others. Comparatively, large-scale learning communities can be constituted by several individuals and learning groups. Although members of learning communities still engage in their own learning activities and non-study related tasks, their activities can be supported by shared learning materials and learning-supportive facilities provided by the design studio learning environment of physical design studios. Nevertheless, these conditions above do not imply that only physical design studios and tutorial spaces can generate such a shared repertoire. The findings from interviews and focus groups will reveal more forms of communities of practice wherever within or outside physical design studios.

5.2.2 Findings from Interviews and Focus Groups

Compared with the themes coded from data of observations, the data collected from interviews and focus groups indicate that there is generally more information of students' informal learning activities between peers. For example, as shown in Figure 16, it was

found that there are more modes of a shared repertoire between students. Specifically, through interviews and focus groups, six characteristics of a shared repertoire were found, which are “Historical Events”, “Concepts”, “Stories”, “Styles”, “Tools”, and “Actions”. Within these themes, “Tools” and “Actions” are explained in Section 5.2.1. As for the other five characteristics regarding informal learning between peers, “Historical Events” refers to some mutual experiences happened among all members of the community of practice, and this specifically means, in this thesis, the learning experience in virtual learning environments during the “work from home” period of the COVID-19 pandemic. “Concepts” in this thesis refers to some mutual concepts that students have when they engage in informal learning activities between peers, such as “sweating”[3]. “Stories” in this thesis refers to some mutual events that students actively have had when they engage in informal learning activities between peers. “Styles” in this thesis refers to the styles of informal learning between peers that students are used to engage in. The generation of sub-themes is complicated under the theme of a shared repertoire, since there is not only a single shared repertoire generated by study participants’ informal learning activities between peers. For example, under the theme of “Actions”, some students always need help from others when they study within their design studios, but they tend to do that with their friends and study companions rather than a random person. Some other students, instead, enjoy in learning within their design studios outside their formal timetable activities assisted by learning- and living-supportive facilities around their design studios, and they typically regard the design studio learning environment within their design studios as a shared learning community to ask for help from everyone else rather than their friends and study companions. Some others just select a random place to engage in their informal learning activities between peers, and they can join random learning groups

[3] An informal term pointed out by architecture students in the Welsh School of Architecture, describing some students’ hardworking within the design studio learning environment, and their hardworking makes others to work harder, just like people who sweat very hard-working in the gym.

or a learning community whatever they like. It is noticeable that the cubes within the hatch Green rectangle on the right side of the coding diagram depicts an inductive process. Specifically, the collected data are firstly classified according to their common characteristics, and such characteristics are further coded into specific themes, which are ultimately coded into the final theme. Based on these characteristics, accordingly, all sub-themes are coded into three themes, indicating three forms of informal learning between peers, which are "learning group" in a small scale, "learning community" in a large scale, and "learning guerilla" in no specific scales. Specifically, different "Historical Events", "Concepts", "Stories", "Styles", "Tools", and "Actions" are generated from various peer-to-peer engagements between students, enabling students to typically constitute these three forms of informal learning between peers. The related data regarding these six characteristics are elaborated below.

Figure 16 The Thematic Map of A Shared Repertoire Collected from Interviews and Focus Groups

Under the theme of "Historical Events", it was found that students all experienced virtual learning in isolation during the "work from home" period of COVID-19 pandemic. Due to this historical event, students lost their design studio learning environment of physical design studios. After that, it was found from some interviewees that the design studio learning environment within physical spaces is not replaceable for constituting communities of practice. For example, Student F-Year 3 indicated his experiences of maintaining a learning group with his friends within the virtual learning environment and physical design studios, respectively.

> *Student F-Year 3: "...my 2nd-year was totally working at home, and we communicated with each other through social media. It's so difficult to know each other, cause we were facing screens. Currently, I can see others in person, so I can arrange more time to know everyone...If I'm stuck, I would just scroll*

through social media, so I could not get as much as motivation to do productive socialising."

Besides, Student D-Year 2 indicated that the design studio learning environment was disabled since there were no shared learning materials when they were studying at home.

Student D-Year 2: "Architecture students are used to seeing all the individual work of everyone else and share resources, such as a lot of drawings, advice, and ideas, with each other, but we could only discuss it in front of our screens in the virtual studio."

Even though, it was also found that without the design studio learning environment of physical design studios, some students could still try their best to maintain a design studio learning environment with their friends and study companions by alternative methods. For example, Student A-Year 3 described:

Student A-Year 3: "When I was studying within my home during the 'work from home' period, we Chinese students frequently communicated as a group talk on WeChat. We usually talk with each other when we encounter some tough issues, and we could share some valuable learning materials through the sharing function on WeChat. It was so grateful that there were distance communication applications during that period."

Just because of the innovated technologies during the "work from home" period, architecture students could maintain a shared repertoire with others as the form of small-scale learning groups in virtual learning environments outside formal timetable activities. However, there is no sense of "sweating" in these self-organised design studio learning environments in virtual learning environment. Consequently, under the theme of "Concepts", it was found from some interviewees that "sweating" can only be felt in the design studio learning environment in physical design studios. For example:

Student A-Year 2: "Definitely, I think the learning environment in the design studio can motivate me to work harder. Some ones are pretty 'sweating', and I want to know if I can be better since I check their design works. But, there is no this feeling in other spaces. Yeah."

Student J-Year 2: "I basically regard 'sweating' as the motivation for me. Just like, oh, they're doing that, I'm gonna do a better one and try my best to chase them."

Student C-Year 2: "Most of us 2nd-year students tend to study in our design studio. You can always see a lot of students studying in it in most cases. It has

already been a mutual learning space. The learning environment motivates us a lot to 'sweating' a lot, but there's no this feeling studying in other places."

Besides the concept of "sweating" brought by the design studio learning environment of physical design studio, there are also some literal acquisitions brought by such learning environment. Under the theme of "Stories", it was found by interviews that some students used to have mutual experiences to know and get familiar with others, so that they can have more engagements with others. For example, some interviewees emphasised that social activities, which were organised by student associations, ensured engagements between different individuals.

Student F-Year 2: "Oh, we know each other at the Winter Ball…I think the vide of our social activities was so good. I got the chance to know others and learn something from them…You know there are rare opportunities to meet everyone after class, so these social activities filled these gaps."

Student D-Year 2: "One of the best reasons to constitute the peer learning environment, as you can see here (within the 2nd-year design studio), is that there are some social activities organised by the Student Association of the Welsh School of Architecture in their normal time. Some of those students even became close friends after these activities, and they prefer to sit together as a stable learning group. I organised some activities such as dinner parties and tours for our students. Those activities literally help constitute the bonds between most of the individuals."

Since the significance of design studio learning environment within physical design studios and peer-to-peer engagement between students to maintain a shared repertoire was found from interviewees' accounts above, students still have different styles of constituting communities of practice. Specifically, under the theme of "Styles", it was found from interviewees that face-to-face communications between peers is helpful to support their own learning. Thus, some interviewees indicated that they usually exchange design ideas and learning materials with their friends and study companions face-to-face wherever within to outside physical design studios. For example:

Student G-Year 3: "…I need to communicate with my friends face-to-face to fill my gaps that I can't finish by myself. Some knowledge is abstract, and you can't describe it by words. Some is practical, and you need others to operate in front of you, so that you can understand."

> *Student H-Year 3: "I like to communicate with others about their design projects. Me and my friends form a study group, and we can study together. Sometimes we share with each other some online sources about architectural knowledge, or we can discuss our portfolios. Yeah, I think it's really helpful for our own learning."*
> *Student J-Year 3: "…I usually study with my friends in downstairs at her student accommodation. I used to study at mine, but I'm now living in the house, the electricity bill increased significantly. I can't afford it if I keep staying in it all day long, so I study with my friend in other places. Even though we study together, we both normally do our own business and casually discuss some questions."*

Comparatively, some others emphasised that only the design studio learning environment within physical design studios can maintain the peer-to-peer engagement with their friends and study companions, so they usually study with peers within their physical design studios for a prolonged period almost everyday. For example:

> *Student M-Year 3: "I believe that our relationships relate to unit activities. You can see these two lines of tables at the back side of our studio are lifted for drawing because we belong to unit one, and our tutor asked us to draw a giant site plan. We are drawing together these days, and we are really in good relationships after these days' work."*
> *Student H-Year 2: "Oh, me and my friends really enjoy studying within our design studio…we usually catch up some snacks at the vending machine downstairs for our lunch…sometimes go out around and come back…it's pretty easy to city centre and other university facilities from our school building."*

Even though, some interviewees supplied that there is no need to stay within physical design studios every day. By contrast, they usually study in individual and just casually study with peers within physical design studios. For example:

> *Student E-Year 2: "I hardly go to our design studio because I prefer the individual learning environment within my own room. Even though, when I encounter some tough issues with my design project, I would like to ask for help from others in the design studio because perspectives from multiple sources are more productive than working by myself. Meanwhile, they would also ask for some suggestions for their portfolio from my perceptions, because the views and suggestions are more valuable sourced from a 'stranger' [a person who hardly learning within the design studio] … Me and my friends can get inspirations from others learning in the studio."*

> *Student F-Year 2: "I only come to the studio to make physical models and to check the progress of other students' design work. Otherwise, I always learn within my own room or public spaces in student accommodations. Although others in the studio can help me to check my portfolio, I don't need them all the time, so I don't think the learning environment within the design studio facilitate my own learning. I only feel messy in it. What I need is others' voices, but these voices are mostly from the design studio."*

Some other students even indicated that these peer-to-peer engagements can be maintained by virtual learning environment. For example:

> *Student C-Year 2: "I think we architecture students are necessary to obtain knowledge from communicating with others about their design ideas and thinking. It a good way to make progress. Sometimes I study by my own when I feel bad, but I still insist on communicating with friends through social media when I encounter problems to ensure my work in process."*

It is known from interviewees' accounts above that a shared repertoire can be maintained by peer-to-peer engagements and design studio learning environment within physical design studios. Besides, some external factors within the design studio learning environment. Specifically, under the theme of "Artefacts", some interviewees articulated some details of making physical models and drawings for sharing with peers within their physical design studios. For example:

> *Student A-Year 2: "Studio environment really helpful for self-ability. Cause we can do model making and learn technological knowledge and digital programme. As the plenty of models made within the design studio, we have many opportunities to learn from the ones who can make great models. Compared with that, it's too quiet to do these things in the hybrid studio."*
> *Student K-Year 2: "We can leave big stuff, such as physical models, within the studio. And the next time we study here we can just use them very easily. There're no other places to place them outside the design studio."*
> *Student K-Year 3: "…You can put your models and drawing paper on tables, and there are some site plans and learning materials pinned up on the wall, so we can walk around in the design studio to look through these references for inspiring your own design ideas…"*

Accordingly, just because of the design studio learning environment within physical design studios where people present, students can make physical models and drawings and leave at random tables for sharing. In addition, there are many learning- and living-supportive facilities around students' physical design studios, students can engage in

distinct activities within their physical design studios. Since the elements of constituting a shared repertoire are found from interviewees' accounts above, it is necessary to know students' specific actions. Thus, under the theme of "Actions", it was found from study participants that students had distinct actions when they were engaged in informal learning between peers. For example, to obtain a comprehensive view of architecture students' actions within the design studio learning environments in physical design studios, some interviewees supplement some details of their non-study related activities occurring within such learning environment. For example, some interviewees articulated some scenes of activities within physical design studios outside formal timetable:

> *Student D-Year 2: "…some of them sitting at these benches to have lunch or snacks, and they chatted for a little while before going back to the studio…while others spent more time within the kitchen…as for me, I normally come here after lunch, but I usually use the computer within the IT room beside our studio to upload design work so that I can print it in the plotter room just opposite the IT room… As you can see, these guys are always staying within the design studio for whole days. They seemed to be learning very hard, but they may watch videos or chat with others rather than doing their own design projects. Even though, we still prefer coming to the design studio as everyone we are familiar present, so that we can engage in the learning environment."*
>
> *Student G-Year 2: "Actually, our design studio is kind of a social place. I can meet a lot of students there. I usually stay in it during tutorial days. Especially, the kitchen in front of our studio is a nice place for social activities. We can meet our fellows or some 3rd-year students by accident during the break of each tutorial, and some casual chats just happened within that space."*

However, even though the design studio learning environment within physical design studios can satisfy distinct learning and non-study related activities, some other students still engaged in informal learning with their friends rarely within physical design studios when they were outside formal timetable activities. For example, some interviewees indicated their initiatives of selecting study spaces when they engaged in informal learning between peers:

> *Student G-Year 2: "When it is raining or highly windy, my friends and I study within our own rooms to avoid the bad weather during the commute between the accommodation and the school building. Just in case we do not know*

other's design process, we communicate with each other on What's App and check the Miro…Whether I go to the design studio depends highly on the weather. Since it often rained recently, it also takes me about 30 minutes to commute from my accommodation to Bute Building [the school building of the Welsh School of Architecture], so I hardly go to the studio recently. Many of my fellows also do that. Fortunately, the tutorial is hybrid now, so I can do it on the laptop in my room."

Student L-Year 2: "I don't like the learning environment within the design studio, cause I'm easily distracted by voices, but the living cost has been increased dramatically, so I can study here to save some costs of the bill. And, I don't mind commuting from my home to the school, so I sometimes study in the design studio. Anyway, to avoid wasting a lot of time from distractions, I still prefer individual learning in my own home."

In addition, some study participants articulated more details and reasons of selecting study spaces when they were taken focus groups. For example, some students preferred to engage in informal learning with their friends or some ones who were familiar when they were within physical design studios, as shown in Focus Group 1.1.1, 28th April, Thursday 2022:

Student A-Year 1: Not really, we study in the design studio to do our AT1 assignment. We used to study in individual. Actually, this is our first time studying in group.

Student B-Year 1: Yeah, we can't complete this assignment on one's own, cause our deadline of AT1 is approaching, and we do the assignment together to increase our efficiency.

Student C-Year 1: Exactually, we can help each other, cause each of us is good at specific aspects.

Student B-Year 1: We knew each other before, cause we all from China, but we normally studied at home for design projects, but architectural technology is totally different. Cause design can copy others' ideas from online resources, but the AT needs calculation and analysis by specific software.

Likewise, as shown in Focus Group 2.1.2-2, 16th November, Wednesday 2022:

Student J-Year 2: Yeah of course. We both like to study in peers. She is my today's study partner.

Student K-Year 2: Yeah, I came to the design studio to develop my portfolio, and I found that she is also here. I just have a problem on my design project, so I asked her how to figure it out.

Student J-Year 2: Indeed, she asked me how her model can be developed to fit for the site better and the ways to optimise the circulation system if the model if developed.

Student K-Year 2: She provided me some available methods to develop my model, yeah, the model is present here, so we're both clear to know the details on that. I think that there're some other ways, so I plan to ask more suggestions from others.

In addition, as shown in Focus Group 3.1.2-1, 11th May, Wednesday 2022:

Student H-Year 3: Yeah, of course. Me and my friends usually appoint to study together at the design studio. While during the process, we normally focus on our own tasks and occasionally discuss about the difficulties we encountered. It [wearing headphones] is helpful to concentrate more on my learning and prevent me from the outside world.

Student I-Year 3: I always discuss with my fellows to ask for advice and suggestions for my design project, which inspire me a lot of ideas for my design project with high efficiencies.

In a word, it is known from these students' accounts that they have the tendency to study with others who have established peer-to-peer engagements when outside their formal timetable activities. Comparatively, some others normally not only have peer-to-peer engagements between their friends, but they can also extend their engagements to others. For example:

Student B-Year 3: "Well, I usually study at home actually, but me and my friends would also like to appoint a slot to study at downstairs in his accommodation or mine. There're public tables for the group study, and we can study at some idle slots, but other slots maybe too loud, so we sometimes appoint to study in the hybrid studio [tutorial space]… I would study within the design studio more frequent if it is close to my living place."

Student F-Year 3: "Me and my friends usually form a small study group at hybrid studio [tutorial space], and sometimes we would also invite others to join our group. For instance, today we three study in this unit, and last time (pointing to his friend), do you remember that guy joined us? Yeah, we welcome everyone to join us."

However, in comparison to these peer-to-peer engagements generated by the design studio learning environments within physical design studios, virtual learning in remote ways resulted in the loss of the design studio learning environment and peer-to-peer engagements to a certain extent. For example, some students indicated some difficulties of constructing peer-to-peer engagements, during the "work from home" period, maintaining an alternative design studio learning environment:

> *Student A-Year 1: "There was no opportunity to communicate with others after course and tutorials when I had remote learning in China. I had no idea what others' design process was and the ways to learn from others, which was so helpless. Fortunately, my parents are working in relevant fields, so I could ask for help from them sometimes, but it is still different to do it with peers in good relationships."*
> *Student H-Year 2: "I think (that) it is totally different to study with others within the virtual environment and design studio. There was no sense that a lot of friends were learning within the same place when we were online during the pandemic. We regard the design studio as a daily learning place. We can study, recreate, chat, and eat all together when we study within the design studio. That's our tacit understanding that only happens within the studio environment. I believe it [studying with friends] brings me benefits on my design skills and the sense of working place in the future."*

Fortunately, there are some social activities, which are organised by SAWSA (The Student Association at the Welsh School of Architecture) specifically for undergraduate students, such as Summer Ball and Winter Ball, thereby enabling students to become more acquainted with each other. For example, as Student D-Year 2 indicated:

> *Student D-Year 2: "I organised some activities such as dinner parties and tours for our students. Those activities literally help constitute the bonds between most of the individuals."*

In summary, as indicated by some study participants above, the design studio learning environment within the physical design studio, where many students study while doing their own learning activities and other tasks, offers architecture students a space to form peer-to-peer engagements. Besides, social activities enabled by student associations and learning-supportive facilities around physical design studios encouraged some students to create more peer-to-peer engagements with others. Even though, the design studio learning environment within physical design studios is not the only option for constituting communities of practice. Thus, architecture students organise their communities of practice in different forms. Specifically, some students usually constitute small-scale learning groups with their friends and study companions at home or non-timetabled learning spaces outside physical design studios; Some students usually study within the design studio learning environment of physical design studios for a prolonged period; Some students usually study at home in individual and contact with others by virtual

contact methods, but they insisted on casually studied within physical design studios for asking help from others.

5.2.3 A Shared Repertoire is Sourced from Different Forms of Communities of Practice

In summary, although there are no obvious differences of final themes between these two datasets, the themes generated by the data from interviews and focus groups not only identified but also supplied those from observations. For example, under the theme of a shared repertoire, data collected from interviews and focus groups eventually found three forms of communities of practice constituted by architecture students' informal learning between peers, and they supplied two forms of communities of practice found from observations.

It was found by the investigation that architecture students tended to undergo informal learning between peers outside formal timetable activities in three main forms of communities of practice composed of several specific individuals within diverse learning environments. Specifically, these three forms of communities of practice are namely "learning group" (typically small-scale with 2-8 members), "learning community" (typically large scale with more than 8 members), and "learning guerilla" (typically organised by the individuals who have no specific preferences on learning modes). Within these three forms of, students develop a shared repertoire based on the design studio learning environment and peer-to-peer engagements.

1. Accordingly, students tend to organise learning groups with specific friends and study companions who have established strong peer-to-peer engagements, from which they can seek help and discuss questions efficiently. In other word, these students are typically friends or specific study companions. Learning groups can be organised wherever within the design studio learning environment within physical design studios or a design studio learning environment constituted by students outside physical design studios, including non-timetabled learning spaces on campus, public learning spaces in student accommodation, students' own

rooms, and even virtual learning environments. Even though, these students generally work on their own tasks and casually communicate with companions when they engage in informal learning activities within such design studio learning environments.

2. Comparatively, a learning community is typically constituted by several individuals and learning groups within the design studio learning environment of physical design studios. There are distinct learning materials and learning-supportive facilities shared for community members within such design studio learning environment, in which these learning groups and individuals generally work on their own learning activities and other tasks. In addition, peer-to-peer engagements between students are various within learning communities, since the interactions between each person and learning group occur occasionally.
3. Besides learning groups and learning communities mentioned above, it is an interesting phenomenon that some students have no specific preferences on engaging in these two modes of informal learning, and they can join several learning groups and a learning community whatever they like. In other words, the choice of informal learning modes is based on what they literally need, constituting their learning guerillas. Specifically, some students normally study by themselves or with their friends, but they still join the learning community casually when they need suggestions from others. In a word, these students tend to join or organise a design studio learning environment within random spaces.

After all, the small-scale learning groups, which is typically maintained by the established peer-to-peer engagements, are regarded as a “comfort zone” to many students, while the weak ones in the large-scale learning community to some extent prevent some students from engaging in informal learning between peers within physical design studios, even though they know they can acquire more knowledge and inspirations from checking more students’ design works and portfolio in physical design studios. To immerse in this “comfort zone” and acquire essential knowledge from peers simultaneously, some

students engaged in both small-scale learning groups with their friends and/or study companions by distance contact methods and large-scale learning communities within their design studios whatever they liked, acting as learning guerillas.

However, it was found from Year Chairs' accounts that even though the design studio learning environment enabled many students to build peer-to-peer engagements, many students were still reluctant to spontaneously engage in informal learning between peers outside formal timetable activities. For example:

> *1st-Year Chair: "Even though someone knows that there are students who got high grades, they are reluctant to look at or learn from the high-grade projects."*
> *2nd-Year Chair: "Typically, the more they collaborated, the more knowledge they obtained. However, some of them are still reluctant to study with others within the design studio, even though they know the benefits of learning together…The design outcomes of some students have not reached the level that the academic year should reach…the gaps among students are getting more and more obvious throughout the semester, even though they were initially at the same level of academic learning."*

Thus, to solve this issue, some student associations of the Welsh School of Architecture organised several social activities to build connections between students, in further to enhance students' peer-to-peer engagements when they engaged in informal learning. In a word, the more peer-to-peer engagements constructed, the more willingness to engaging in informal learning as the form of large-scale learning communities.

In summary, finding a means to create or join a design studio learning environment is significant for these study participants' informal learning as it expedites the process of entering a working mood. In other words, if there are opportunities or occasions for study participants in my thesis to cultivate their peer-to-peer engagements, they are then inclined to spontaneously organise a stable learning group and even join a learning community with multiple individuals. Conversely, if there are no opportunities for students to establish peer-to-peer engagements with each other, they might be reluctant to join learning communities on a large scale than their specific learning group. Since the three types of architecture students' informal learning between peers were disclosed in

this section, the specific ways that students form those three types are expounded in the next two sections.

5.3 Mutual Engagement

It was found from the last section that students' peer-to-peer engagements and the design studio learning environment within physical design studios are significant for students to constitute communities of practice. This section specifically analyses the data regarding peer-to-peer engagements between students. It was found that students' peer-to-peer engagements in different forms of communities of practice are reduced to mutual engagement, and the following sections elaborate on the specific findings from related data. Wenger (1998) articulated that mutual engagement refers to the relationships that bind community members as a unity, including characteristics of engaged diversity, doing things together, social complexity, community, and maintenance. Wenger (1998) explains these characteristics for communities of practice below.

- The act of "doing things together" implies that despite the commonalities in the backgrounds of community members, specific coordination is nonetheless essential when they engage in collective activities.
- "Engaged diversity" pertains to the active and purposeful participation of diverse individuals in the processes, decision-making, and community-building efforts within the community of practice. It places emphasis on collaboration, open communication, and continuous involvement of all community members, guaranteeing that all voices are heard and respected.
- "Social complexity" refers to a complex social system in which individuals interact frequently in various contexts with a multitude of different individuals and, over time, often have repeated interactions with many of the same individuals.
- "Community" suggests that mutual engagement represents a type of community that does not necessitate homogeneity.
- "Maintenance" involves certain peripheral tasks that make the daily work more manageable and tolerable for everyone within the community.

The definition of these characteristics of mutual engagement is interpreted by the voice of architecture students' informal learning between peers in the coding system of this thesis, as indicated in the following two sections.

5.3.1 Findings from Observations

All observations were taken on campus only, so the data collected from observations only manifest limited information of all types of informal learning activities between peers. For example, Figure 17 illustrates the coding process of the data collected from observations under the theme of mutual engagement. Specifically, field notes of six observations manifest two characteristics of mutual engagement, which indicate "Social Complexity" and "Engaged Diversity". As for the explanation of these two characteristics regarding to informal learning between peers in this thesis, "Social Complexity" refers to the complexity of social relationships and informal learning activities among different learning groups or within a learning community. "Engaged Diversity" refers to that students in different learning groups usually engage in specific informal learning activities between peers, so there are diverse informal learning activities occurring when different learning groups presenting simultaneously. It is noticeable that the cubes within the hatch Green rectangle on the right side of the coding diagram depicts an inductive process. Specifically, the collected data are firstly classified according to their common characteristics, and such characteristics are further coded into specific themes, which are ultimately coded into the final theme. Accordingly, all data regarding "Social Complexity" were coded into the theme of "students organise their specific learning groups but work on their own learning and other tasks within design studios". All data regarding "Engaged Diversity" were coded into the theme of "students in different learning groups generally have specific tasks within design studios". These two themes were combined and interpreted into the theme of "students can engage in a complex of mutual engagement face-to-face within physical design studios". The related data regarding these two characteristics are elaborated on below.

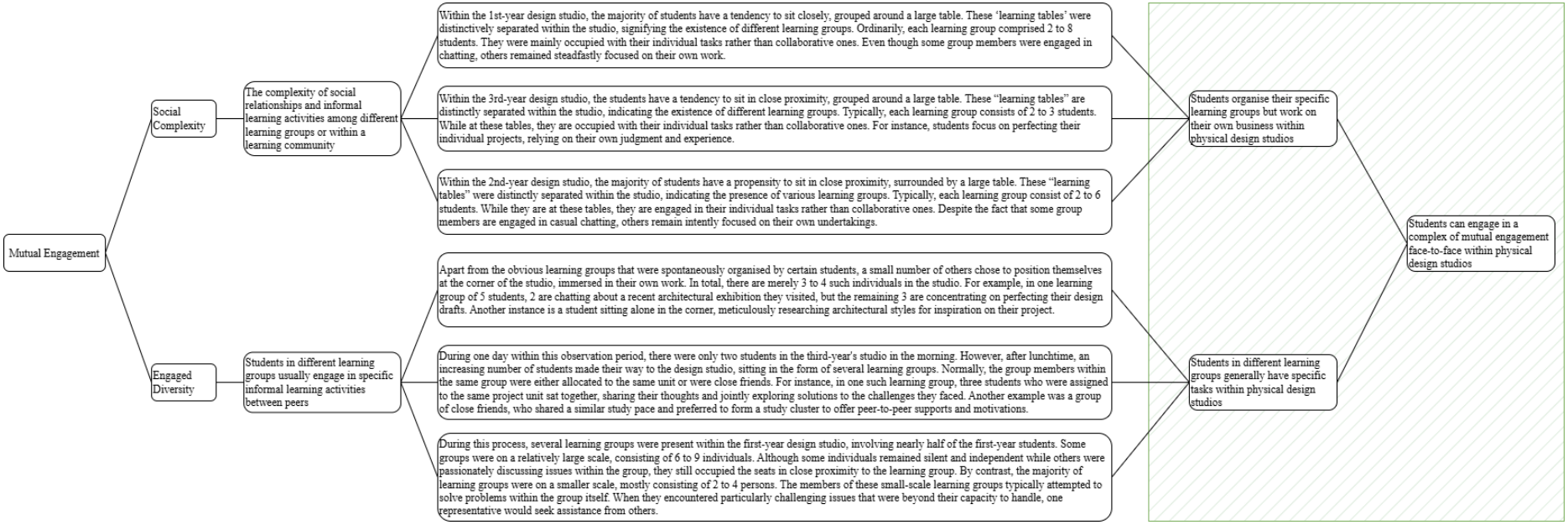

Figure 17 The Thematic Map of Mutual Engagement Collected from Observations

Under the theme of "Social Complexity", as indicated in the previous section, architecture students frequently organise different forms of "learning clusters" outside formal timetable activities. Within such learning clusters, students typically aimed to seek help and obtain motivation, and their interactions were strengthened during such conditions. For example, as shown in Field Notes 1.1.1-2, 16.00-19.45, 28th April, Thursday 2022:

> Within the first-year design studio, the majority of students have a tendency to sit closely, grouped around a large table. These "learning tables" were distinctively separated within the studio, signifying the existence of different learning groups. Ordinarily, each learning group comprised 2 to 8 students. They were mainly occupied with their individual tasks rather than collaborative ones. Even though some group members were engaged in chatting, others remained steadfastly focused on their own work.

Likewise, students in other two academic years once organised similar learning communities, which was constituted by several learning groups, within their physical design studios. For example, as shown in Field Notes 2.1.1-4, 13.00-15.00, 28th April, Thursday 2022:

> Within the second-year design studio, the majority of students have a propensity to sit in close proximity, surrounded by a large table. These "learning tables" were distinctly separated within the studio, indicating the presence of various learning groups. Typically, each learning group consisted of 2 to 6 students. While they were at these tables, they were engaged in their individual tasks rather than collaborative ones. Despite the fact that some group members were engaged in casual chatting, others remained intently focused on their own undertakings.

In addition, as shown in Field Notes 3.1.1-1, 13.00-15.00, 28th April, Thursday 2022:

> Within the third-year design studio, the students have a tendency to sit in close proximity, grouped around a large table. These "learning tables" are distinctly separated within the studio, indicating the existence of different learning groups. Typically, each learning group consists of 2 to 3 students. While at these tables, they are occupied with their individual tasks rather than collaborative ones. For instance, students more focus on perfecting their individual projects, relying on their own judgment and experience

It can be seen from observations above that peer-to-peer engagements between students are various within large-scale learning communities. Even though, within each learning community, students typically engage in specific learning activities in different small-

scale learning groups. For example, under the theme of "Engaged Diversity", it was found from observations that, students in specific learning groups worked on specific mutual learning and non-study related activities even though they all worked within the same physical design studio. For example, as shown in Field Notes 2.1.1-4, 13.00-15.00, 28th April, Thursday 2022:

> Apart from the obvious learning groups that were spontaneously organised by certain students, a small number of others chose to position themselves at the corner of the studio, immersed in their own work. In total, there were merely 3 to 4 such individuals in the studio. For example, in one learning group of 5 students, 2 were chatting about a recent architectural exhibition they had visited, but the remaining 3 were concentrating on perfecting their design drafts. Another instance was a student sitting alone in the corner, meticulously researching architectural styles for inspiration on their project.

Likewise, as shown in Field Notes 3.1.1-2, 11.00-14.00, 25th-30th April, Monday-Saturday 2022:

> Most students who have a penchant for learning within the studio typically arrive at the studio in the afternoon if there are no sessions or tutorials scheduled in the morning. Subsequently, they usually remain at the studio until the building closes, except when they need to go outside to grab food.
> For example, during one day within this observation period, there were only two students in the third-year's studio in the morning. However, after lunchtime, an increasing number of students made their way to the design studio, sitting in the form of several learning groups. Normally, the group members within the same group were either allocated to the same unit or were close friends. For instance, in one such learning group, three students who were assigned to the same project unit sat together, sharing their thoughts and jointly exploring solutions to the challenges they faced. Another example was a group of close friends, who shared a similar study pace and preferred to form a study cluster to offer peer-to-peer supports and motivations.

In addition, as shown in Field Notes 1.1.1-2, 16.00-19.45, 28th April, Thursday 2022

> During this process, several learning groups were present within the first-year design studio, involving nearly half of the first-year students. Some groups were on a relatively large scale, consisting of 6 to 9 individuals. Although some individuals remained silent and independent while others were passionately discussing issues within the group, they still occupied the seats in close proximity to the learning group. By contrast, the majority of learning groups were on a smaller scale, mostly consisting of 2 to 4 persons. The members of these small-scale learning groups typically attempted to solve

problems within the group itself. When they encountered particularly challenging issues that were beyond their capacity to handle, one representative would seek assistance from others.

It can be manifested from observations above that, based on various peer-to-peer engagements maintained by design studio learning environment within the design studio, these architecture students could engage in a complex of informal learning activities. However, it was not observed that if this complexity can be maintained by the design studio learning environment outside the design studio. The data collected from interviews and focus groups fill this gap in the next section.

5.3.2 Findings from Interviews and Focus Groups

Compared with the themes coded from data of observations, the data collected from interviews and focus groups indicate that there is generally more information of students' informal learning activities between peers. For example, **Error! Reference source not found.** illustrates the data collected from interviews and focus groups under the theme of mutual engagement. Specifically, five characteristics of mutual engagement were found, which are "Doing Things Together", "Social Complexity", "Community", "Maintenance", and "Engaged Diversity". "Social Complexity" and "Engaged Diversity" are explained in Section 5.3.1. As for "Doing Things Together" regarding informal learning between peers in this thesis, it refers to that students engage in learning and other activities with others. "Community" regarding informal learning between peers in this thesis refers to that students engage in informal learning activities with specific friends and study companions as the form of a community. "Maintenance" regarding informal learning between peers in this thesis refers to that students maintain the community as a specific form within a specific learning environment. It is noticeable that the cubes within the hatch Green rectangle on the right side of the coding diagram depicts an inductive process. Specifically, the collected data are firstly classified according to their common characteristics, and such characteristics are further coded into specific themes, which are ultimately coded into the final theme. Accordingly, it is found from data under the themes of "Doing Things Together" and "Social Complexity" that different learning

environments lead to face-to-face and distance contact methods. Under the themes of “Community”, “Maintenance”, and “Engaged Diversity”, it is found that “working isolated” stimulates new contact methods, such as distance contact methods in virtual learning environments. Under the theme of mutual engagement, accordingly, the final theme coded from the data collected from interviews and focus groups is “mutual engagement is generated by different contact methods”. It is noticeable that this final theme is coded from data collected from interviews and focus groups, which are complicated compared to those collected from observations, since observations were all conducted within physical design studios and other learning spaces on campus, lacking aspects of mutual engagement among students off campus. For example, the final theme coded from data collected from observations refers to diverse mutual engagement only generated from the design studio learning environment within physical design studios. By contrast, the final theme coded from data collected from interviews and focus groups not only involves diverse mutual engagement generated from the design studio learning environments within physical design studios, but it also refers to specific mutual engagement generated from the design studio learning environments constituted by students outside physical design studios. The related data regarding these five characteristics are elaborated below.

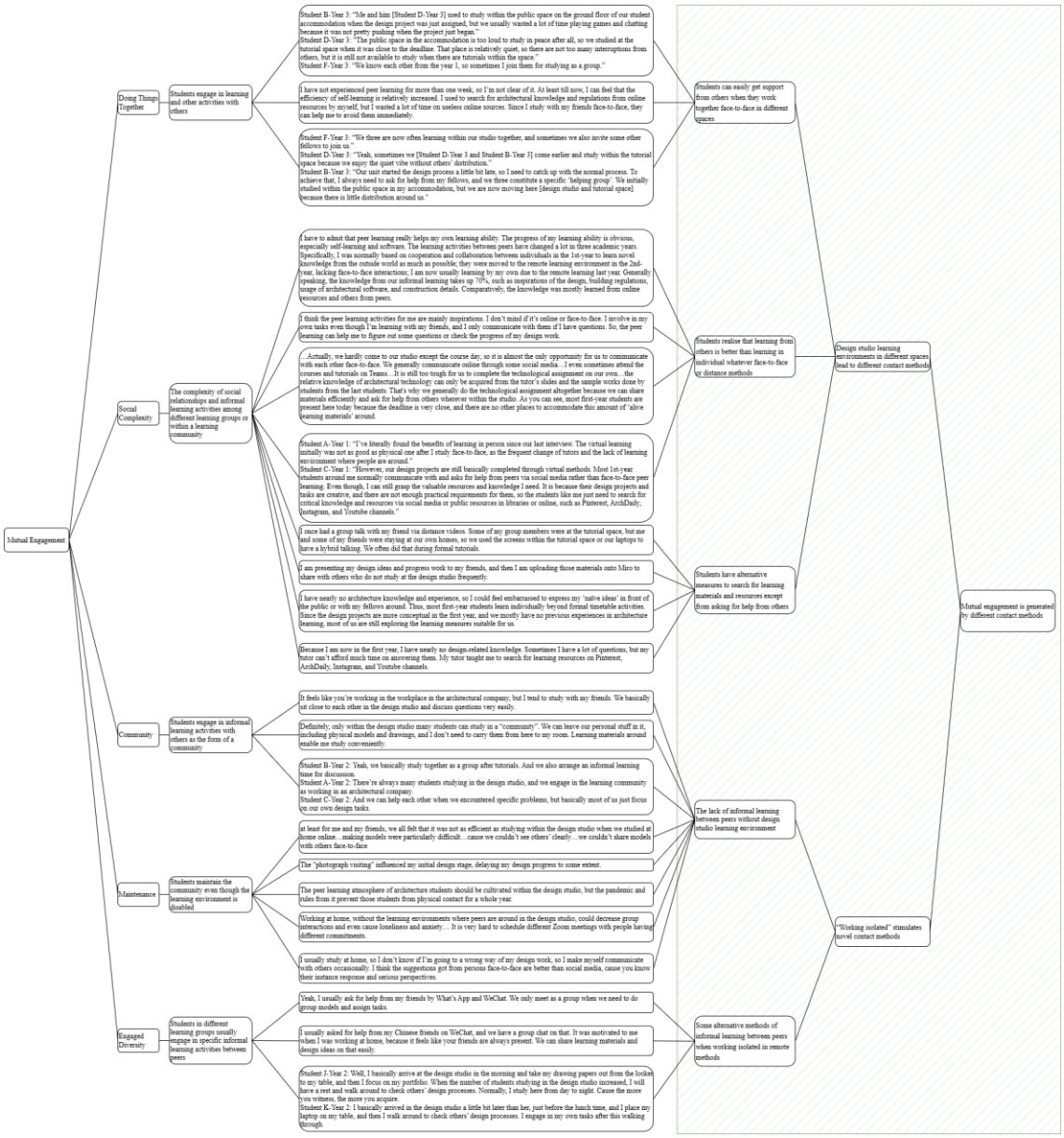

Figure 18 The Thematic Map of Mutual Engagement Collected from Interviews and Focus Groups

Under the theme of "Doing Things Together", through interviews and focus groups, it was found that many architecture students' informal learning experiences between peers occurred within physical design studios, especially when they encounter difficult issues requiring assistance from others. Specifically, within the design studio learning environment in physical design studios, students can acquire specific knowledge and motivations by directly asking their friends or study companions face-to-face, so they can get direct feedback immediately. For example:

> *Student E-Year 3: "I have not experienced peer learning for more than one week, so I'm not clear of it. At least till now, I can feel that the efficiency of self-learning is relatively increased. I used to search for architectural knowledge and regulations from online resources by myself, but I wasted a lot of time on useless online sources. Since I study with my friends face-to-face, they can help me to avoid them immediately."*

Likewise, as indicated by Student B-Year 3, Student D-Year 3, and Student F-Year 3 as the form of Focus Group 3.2.4, these three students were taken a focus group within their physical design studio.

> *Student F-Year 3: "We three are now often learning within our studio together, and sometimes we also invite some other fellows to join us."*
> *Student D-Year 3: "Yeah, sometimes we [Student D-Year 3 and Student B-Year 3] come earlier and study within the tutorial space because we enjoy the quiet vibe without others' distribution."*
> *Student B-Year 3: "Our unit started the design process a little bit late, so I need to catch up with the normal process. To achieve that, I always need to ask for help from my fellows, and we three constitute a specific 'helping group'. We initially studied within the public space in my accommodation, but we are now moving here [design studio and tutorial space] because there is little distribution around us."*

Different from the students who typically engage in informal learning between peers relying on the design studio learning environments in physical design studios, some students can engage in informal learning between peers outside physical design studios. Taking the Focus Group 3.2.4 as an example again, these three students not only studied within physical design studio or tutorial spaces on campus, but they also studied in other spaces off campus depending on whether it was close to the deadline. Specifically, they indicated:

> *Student B-Year 3: "Me and him [Student D-Year 3] used to study within the public space on the ground floor of our student accommodation when the design project was just assigned, but we usually wasted a lot of time playing games and chatting because it was not pretty pushing when the project just began."*
> *Student D-Year 3: "The public space in the accommodation is too loud to study in peace after all, so we studied at the tutorial space when it was close to the deadline. That place is relatively quiet, so there are not too many interruptions from others, but it is still not available to study when there are tutorials within the space."*

Student F-Year 3: "We know each other from the year 1, so sometimes I join them for studying as a group."

Students' accounts above elaborated on the detailed peer-to-peer engagements between architecture students, which mostly occurs within the design studio learning environment of physical design studios or tutorial spaces. Nevertheless, some students still discovered some methods to maintain their peer-to-peer engagements with friends or study companions when they worked in isolation. Meanwhile, since the policy of "work from home" due to the COVID-19 pandemic forced students to stay at a distance and within the virtual environment for one and a half years, it provided this thesis with an opportunity to explore the impacts of "working isolated" on students constituting communities of practice. For example, under the theme of "Social Complexity", it was found from interviews and focus groups that although students worked in the same community of practice, they still engaged in their own learning and non-study related activities. As indicated by Student A-Year 1 and Student C-Year 1 in Focus Group 1.1.1, 28th April, Thursday 2022, even though they helped each other to complete an assignment face-to-face, they still had different perspectives on their working mode. Specifically, they claimed:

Student A-Year 1: "I've literally found the benefits of learning in person since our last interview. The virtual learning initially was not as good as physical one after I study face-to-face, as the frequent change of tutors and the lack of learning environment where people are around."

Student C-Year 1: "However, our design projects are still basically completed through virtual methods. Most 1st-year students around me normally communicate with and asks for help from peers via social media rather than face-to-face peer learning. Even though, I can still grasp the valuable resources and knowledge I need. It is because their design projects and tasks are creative, and there are not enough practical requirements for them, so the students like me just need to search for critical knowledge and resources via social media or public resources in libraries or online, such as Pinterest, ArchDaily, Instagram, and Youtube channels."

Similarly, some other students indicated that they engaged in informal learning between peers by either face-to-face or distance contact methods. For example:

Student E-Year 1: "…Actually, we hardly come to our studio except the course day, so it is almost the only opportunity for us to communicate with each other face-to-face. We generally communicate online through some social media…I even sometimes attend the courses and tutorials on Teams…It is still too tough for us to complete the technological assignment on our own…the relative knowledge of architectural technology can only be acquired from the tutor's slides and the sample works done by students from the last students. That's why we generally do the technological assignment altogether because we can share materials efficiently and ask for help from others wherever within the studio. As you can see, most first-year students are present here today because the deadline is very close, and there are no other places to accommodate this amount of 'alive learning materials' around."

Student G-Year 2: "I think the peer learning activities for me are mainly inspirations. I don't mind if it's online or face-to-face. I involve in my own tasks even though I'm learning with my friends, and I only communicate with them if I have questions. So, the peer learning can help me to figure out some questions or check the progress of my design work."

Student A-Year 3: "I have to admit that peer learning really helps my own learning ability. The progress of my learning ability is obvious, especially self-learning and software. The learning activities between peers have changed a lot in three academic years. Specifically, I was normally based on cooperation and collaboration between individuals in the 1st-year to learn novel knowledge from the outside world as much as possible; they were moved to the remote learning environment in the 2nd-year, lacking face-to-face interactions; I am now usually learning by my own due to the remote learning last year. Generally speaking, the knowledge from our informal learning takes up 70%, such as inspirations of the design, building regulations, usage of architectural software, and construction details. Comparatively, the knowledge was mostly learned from online resources and others from peers."

Even further, some other students can work by face-to-face and distance contact methods simultaneously wherever they work. For example, there are two interviews below showing two different blended learning methods conducted by architecture students:

Student K-Year 3: "I am presenting my design ideas and progress work to my friends, and then I am uploading those materials onto Miro to share with others who do not study at the design studio frequently."

Student G-Year 2: "I once had a group talk with my friend via distance videos. Some of my group members were at the tutorial space, but me and some of my friends were staying at our own homes, so we used the screens within the

tutorial space or our laptops to have a hybrid talking. We often did that during formal tutorials."

Alternatively, unlike students who could acquire knowledge from asking others by both face-to-face and distance contact methods, there is still a considerable portion of students would only acquire essential knowledge by asking questions from their friends and study companions on social media or just searching for architectural projects independently through some online platforms. For example:

Student C-Year 1: "Because I am now in the first year, I have nearly no design-related knowledge. Sometimes I have a lot of questions, but my tutor can't afford much time on answering them. My tutor taught me to search for learning resources on Pinterest, ArchDaily, Instagram, and Youtube channels."
Student A-Year 1: "I have nearly no architecture knowledge and experience, so I could feel embarrassed to express my 'naïve ideas' in front of the public or with my fellows around. Thus, most first-year students learn individually beyond formal timetable activities. Since the design projects are more conceptual in the first year, and we mostly have no previous experiences in architecture learning, most of us are still exploring the learning measures suitable for us."

It is known from students' accounts that although contact methods of architecture students' peer-to-peer engagements are complex, most of them still tend to maintain their engagements as the form of a community where a lot of people present. For example, under the theme of "Community", some interviewees indicated that they worked in their physical design studio as within an architectural company in the future. For example, as students' accounts in Focus Group 2.1.3, 13th May, Friday 2022:

Student B-Year 2: Yeah, we basically study together as a group after tutorials. And we also arrange an informal learning time for discussion.
Student A-Year 2: There're always many students studying in the design studio, and we engage in the learning community as working in an architectural company.
Student C-Year 2: And we can help each other when we encountered specific problems, but basically most of us just focus on our own design tasks.

Likewise, some interviewees also expressed their perceptions on engaging in informal learning with others as the form of a community. For example:

> *Student B-Year 2: "It feels like you're working in the workplace in the architectural company, but I tend to study with my friends. We basically sit close to each other in the design studio and discuss questions very easily."*
> *Student J-Year 2: "Definitely, only within the design studio many students can study in a "community". We can leave our personal stuff in it, including physical models and drawings, and I don't need to carry them from here to my room. Learning materials around enable me study conveniently."*

Besides maintaining face-to-face contact between peers as the form of a community, it is also known from some other students' accounts above that they found alternative contact methods forming a sense of community. For example, under the theme of "Maintenance", it is found that students can also acquire learning materials from others via some specific virtual learning environments, such as social media (Miro, What's App, Message, WeChat, etc.), ensuring that resources are exchanged just like within the design studio. Nevertheless, within such virtual learning environments, it is challenging to rebuild the community as within the design studio learning environment of physical design studios. For example:

> *Student F-Year 3: "…at least for me and my friends, we all felt that it was not as efficient as studying within the design studio when we studied at home online…making models were particularly difficult…cause we couldn't see others' clearly…we couldn't share models with others face-to-face…"*

Another notable change is the site visit in virtual ways. Specifically, the usual way of site visits provides different students with specific perspectives on the site, enabling them to gather relevant data to ensure a comprehensive view on the initial step of the design project. However, students who work from home were unable to visit the site by themselves, so they only conducted the initial design based on photographs taken by other unit members who visited the site in person. Thus, Student B-Graduated, who worked from home during his third academic year, indicated:

> *Student B-Graduated: "The 'photograph visiting' influenced my initial design stage, delaying my design progress to some extent."*

The last but not the least impact of maintaining the design studio learning environment by virtual learning environments is that it can relatively increase the pressures for some students. The pressure stems from multiple sources, including physical and mental. For

example, it disrupts the biological rhythms of some international students who work in their home countries outside the UK, as indicated by Student F-Year 3:

> *Student F-Year 3: "Working at home, without the learning environments where peers are around in the design studio, could decrease group interactions and even cause loneliness and anxiety… It is very hard to schedule different Zoom meetings with people having different commitments."*

Thus, it is totally different between maintaining a sense of community within physical design studios and virtual learning environments. Some students found the solution to make a balance. For example, they usually work in isolation and communicate with others on social media, but they still insist on face-to-face contacting with others casually within their physical design studios, as indicated by Student E-Year 2:

> *Student E-Year 2: "I usually study at home, so I don't know if I'm going to a wrong way of my design work, so I make myself communicate with others occasionally. I think the suggestions got from persons face-to-face are better than social media, cause you know their instance response and serious perspectives."*

It is also found from account of some students, who used to engage in informal learning by distance contact methods, that they had different attempts on maintaining a diversity of peer-to-peer engagements in virtual learning environments. For example, under the theme of "Engaged Diversity", some students became accustomed to working isolated and communicating with others through social media. For example, some interviewees even argued:

> *Student C-Year 1: "Yeah, I usually ask for help from my friends by What's App and WeChat. We only meet as a group when we need to do group models and assign tasks."*
> *Student A-Year 3: "I usually asked for help from my Chinese friends on WeChat, and we have a group chat on that. It was motivated to me when I was working at home, because it feels like your friends are always present. We can share learning materials and design ideas on that easily."*

Nevertheless, it is totally different to constitute the "Engaged Diversity" as within physical design studios. For example, as indicated by Student J-Year 2 and Student K-Year 2 in Focus Group 2.1.2-2, 16th November, Wednesday 2022:

> *Student J-Year 2: Well, I basically arrive at the design studio in the morning and take my drawing papers out from the locker to my table, and then I focus*

on my portfolio. When the number of students studying in the design studio increased, I will have a rest and walk around to check others' design processes. Normally, I study here from day to night. Cause the more you witness, the more you acquire.

Student K-Year 2: I basically arrived in the design studio a little bit later than her, just before the lunch time, and I place my laptop on my table, and then I walk around to check others' design processes. I engage in my own tasks after this walking through.

It can be known from students' accounts that the related technologies, for constituting the design studio learning environment of physical design studios, were developed a lot due to the "work from home" policy caused by the COVID-19 pandemic. Even though, the face-to-face contact methods for maintaining peer-to-peer engagements between students within physical design studios were irreplaceable. Just like statements of Student J-Year 2 and Student K-Year 2, although they worked together as a pair of study companions, they could simultaneously work on their own tasks and walk around for checking others' design projects within their physical design studio. These peer-to-peer engagements were all achieved through face-to-face contacts within physical learning spaces. Comparatively, working isolated disabled both face-to-face contacts and physical learning spaces, so that many students tried their best to keep contacting and sharing learning materials with others, pretending working with others together within physical learning spaces.

5.3.3 Mutual Engagement is Generated by Different Contact Methods

In summary, although there are no obvious differences of final themes between these two datasets, the themes generated by the data from interviews and focus groups not only identified but also supplied those from observations. For example, under the theme of mutual engagement, data collected from interviews and focus groups depicted students' contact methods between different individuals within design studio learning environment within and outside physical design studios, and they supplied face-to-face contact methods within physical design studios only found from observations.

After all, architecture is a practice-based discipline, which means that face-to-face contacts between architecture students are difficult to be replaced by virtual means during the design process. Even so, the aforementioned somehow opposing perceptions do not

imply that “working isolated” is either good or bad for students’ acquisition of architectural learning. Specifically, without face-to-face contact, many architecture students’ learning experiences would be affected by the isolated working environment to a certain extent. Still, others explored and became accustomed to some alternative contact methods to maintain connections with their friends and study companions, such as distance contact measures. Accordingly, face-to-face contact methods are relatively more acceptable for maintaining students’ peer-to-peer engagements with each other. By contrast, distance contacts offer students alternative methods to maintain their engagements when they work isolated in remote or virtual environments, but the effectiveness and efficiency are relatively lower compared with face-to-face contacts.

In general, if architecture students have established peer-to-peer engagements with friends and study companions, they will have greater enthusiasm and energy to engage in the community of practice. For example, it was found that students usually tend to study with their study companions or friends in the form of a small-scale learning group, even though when they study within physical design studios where people are present; Comparatively, if the peer-to-peer engagements are weak, students have relatively limited interactions with others. Specifically, not all students have the sense of undergoing informal learning between peers in the form many people surrounding a table or spreading within the design studio. For instance, according to interviews and focus groups, many individual students are reluctant to study within the learning environment of the design studio where a lot of unfamiliar people, especially the “sweating” ones, are present. On the contrary, they preferred the learning mode during the period of “work from home”, acquiring knowledge and keeping contacts with others via virtual measures.

However, study participants all experienced distance learning within virtual environments due to the pandemic till the end of the year 2021, thus they found their own ways of learning as a group with others even though they are learning in isolation at home. For example, they got accustomed to communicating or seeking help via social media and other related applications, such as Miro, Zooms, What’s App, and WeChat, whenever

during or after the pandemic. Nevertheless, some activities are not feasible via those virtual learning environments, such as checking others' design process within the design studio learning environment where students present, just like the statement of the 1st-Year Chair:

> *1st-Year Chair: "The peer learning atmosphere of architecture students should be cultivated within the design studio, but the pandemic and rules from it prevent those students from physical contact for a whole year."*

As for the specific impacts made by "working isolated", Table 14 illustrates some typical peer-to-peer engagements between architecture students, and they all reveal that face-to-face contacts between students maintain some basic engagements which could inspire or even determine their architectural thinking and design projects.

Table 14 The Comparison of Mutual Engagement When Working Together and Isolated

Peer-to-Peer Engagements	Working Together	Working Isolated	Comparison
Model Making	Students have physical views and feelings of the shared model to learn from the details of the design, materials, weights, inner spaces.	Students basically view models via pictures on Miro and digital model software, losing the physical feelings of the real model.	To have better design and practice, physical group-model making can train architecture students to grasp basic technological knowledge.
Site Visit	Students can feel the site environment in more detail, such as sounds, smells, sunlight, local environments, and the reasonable ways people use the site.	Students can only view the site through pictures taken by others or Google map, losing the physical feeling of the surroundings.	To ensure the architectural design is more reasonable, it should be suitable for the local site, but the virtual environment takes the opportunity for site visits away.
Checking Others' Design Process	Students can brainstorm and share their ideas face-to-face, get inspiration more directly.	Students exchange findings from site visits and discuss their design ideas via virtual platforms.	Students need to develop their design projects through checking others' design process in the design studio learning environment of physical spaces, but the virtual means weaken the physical contacts.
Normal Communication	Students can ask for help or help others randomly via walking around within the design studio; Besides, they are free to communicate with others within the design studio learning environment.	Students communicate with peers casually via social media outside the formal sessions, sharing links to learning resources, exchanging design ideas, sharing the pressure by complains.	The physical environment can provide students with the full view and actual feelings of the surroundings so that everyone is engaged in the mutual atmosphere. However, the virtual environment cannot ensure those aspects, so the efficiency of communications is comparatively low.

5.4 A Joint Enterprise

Besides peer-to-peer engagements between students, the past two sections also emphasised that the design studio learning environment is significant to architecture students constituting their communities of practice. This section will elaborate on the specific ways that architecture students constitute the design studio learning environment as a joint enterprise for their communities of practice. Wenger's (1998) claimed that a joint enterprise results from a collective negotiation process that reflects the full complexity of mutual engagement, including characteristics of negotiated enterprise, mutual accountability, interpretation, and rhythms. Wenger (1998) explains these characteristics for communities of practice below.

- "Negotiated enterprise" implies that the unity of an enterprise does not stem from everyone sharing the exact same beliefs or unanimously agreeing on all matters, but rather from a process of communal negotiation. In this process, community members are compelled to seek a means to embrace both similar and dissimilar forms of engagement. They must even learn to live with their differences and coordinate their respective aspirations, which constitutes a crucial part of the overall process.
- The act of negotiating a joint enterprise gives birth to relationships of "mutual accountability" among the involved parties. Some aspects of "mutual accountability" within the joint enterprise may sometimes trigger intense expressions and discussions. However, within the context of a community of practice, these disputes will eventually evolve into commonly accepted concepts, enabling community members to negotiate the appropriateness of their actions.
- "Interpretation" means that a joint enterprise develops within specific historical, social, cultural, and institutional contexts, which provide both particular resources and impose corresponding constraints. Nevertheless, its day-to-day practical operation is shaped by the participants within the framework of the resources and limitations of their respective situations. The significance of interpretation also

lies in the fact that, in order to fulfil the tasks expected of them, community members will carry out practical activities in a creative manner that is unique to them.

- "Rhythm" is like an integral part of vivid and dynamic music, capable of skilfully coordinating the process of music generation. If it is detached from the performing context, rhythm will lose its vitality, becoming rigid, monotonous, and meaningless. But during the actual performance, it can endow the music with the characteristics of interpretability, participation, and shareability.

The definition of these characteristics of a joint enterprise is interpreted by the voice of architecture students' informal learning between peers in the coding system of this thesis, as indicated in the following two sections.

5.4.1 Findings from Observations

All observations were taken on campus only, so the data collected from observations only manifest limited information of all types of informal learning activities between peers. For example, Figure 19 illustrates the coding process of the data collected from observations under the theme of a joint enterprise. Specifically, through eleven observations, three characteristics of a joint enterprise were found, which are "Rhythms", "Mutual Accountability", and "Negotiate Enterprise". As for the explanation of these three characteristics regarding informal learning between peers in this thesis, "Rhythms" refers to daily routines of study participants' informal learning activities within the design studio learning environment in their design studios, such as their arriving and leaving time, study places, usual learning activities, the people who they like to communicate with, etc. "Mutual Accountability" refers to that some students usually engage in informal learning activities with some specific friends and/or study companions, and they can check each other's ideas, work processes, and projects. "Negotiated Enterprise" refers to that specific learning mode after several attempts of informal learning activities between peers. It is noticeable that the cubes within the hatch Green rectangle on the right side of the coding diagram depicts an inductive process. Specifically, the collected data are firstly

classified according to their common characteristics, and such characteristics are further coded into specific themes, which are ultimately coded into the final theme. Accordingly, the themes “Rhythms”, “Mutual Accountability”, and “Negotiate Enterprise” were ultimately coded into one theme “a joint enterprise is ensured by the design studio learning environment”. The related data regarding these three characteristics are elaborated below.

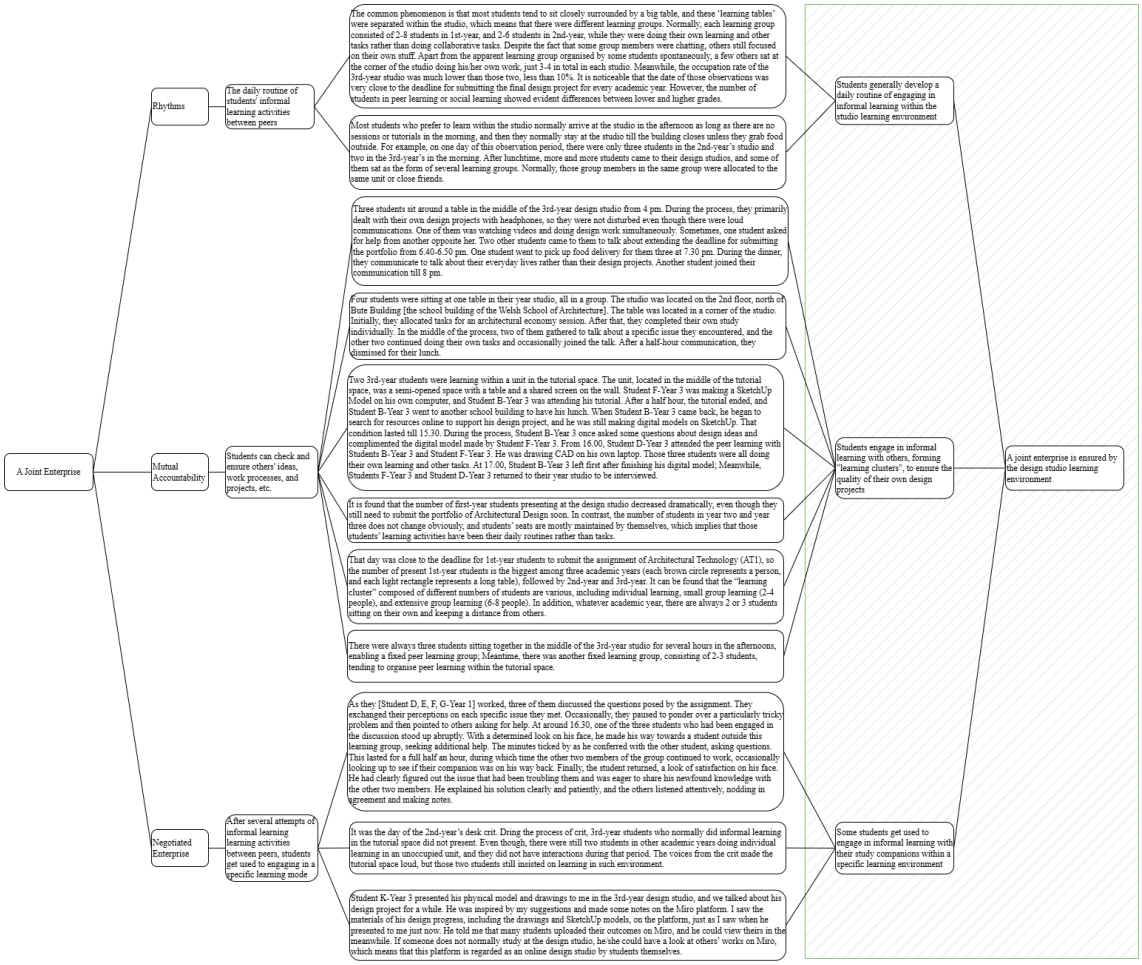

Figure 19 The Thematic Map of A Joint Enterprise Collected from Observations

Under the theme of “Rhythms”, it was found by observations that many students cultivated their rhythms of informal learning within the design studio learning environment in physical design studios. Specifically, students regarded this learning environment as an appropriate place to share and spend their daily lives with their friends and peers. For example, to explore the design studio learning environment in detail, there was an observation of 1st-, 2nd-, and 3rd-year students in the Welsh School of Architecture, indicating that the occupation rate of the studio was 30%-40% in all three academic years’

studios, as shown in Field Notes 1.1.1-2, 2.1.1-4, 3.1.1-1, 13.00-15.00, 28th April, Thursday 2022:

> The common phenomenon is that most students tend to sit closely surrounded by a big table, and these 'learning tables' were separated within the studio, which means that there were different learning groups. Normally, each learning group consisted of 2-8 students in 1st-year, and 2-6 students in 2nd-year, while they were doing their own learning and other tasks rather than doing collaborative tasks. Despite the fact that some group members were chatting, others still focused on their own stuff. Apart from the apparent learning group organised by some students spontaneously, a few others sat at the corner of the studio doing his/her own work, just 3-4 in total in each studio. Meanwhile, the occupation rate of the 3rd-year studio was much lower than those two, less than 10%. It is noticeable that the date of those observations was very close to the deadline for submitting the final design project for every academic year. However, the number of students in peer learning or social learning showed evident differences between lower and higher grades.

Another phenomenon is that most students' arrival time at their design studio are typically determined by their course and tutorial time in the school building, as shown in the Field Notes 2.1.1-3, 3.1.1-2, 11.00-14.00, 25th-30th April, Monday-Saturday 2022:

> Most students who prefer to learn within the studio normally arrive at the studio in the afternoon as long as there are no sessions or tutorials in the morning, and then they normally stay at the studio till the building closes unless they grab food outside. For example, on one day of this observation period, there were only three students in the 2nd-year's studio and two in the 3rd-year's in the morning. After lunchtime, more and more students came to their design studios, and some of them sat as the form of several learning groups. Normally, those group members in the same group were allocated to the same unit or close friends.

It is known from observations above that many students cultivated a rhythm of engaging in informal learning in the design studio learning environment of physical design studios. Regarding the reasons, many of them regarded this learning mode as the way to ensure that they were not going wrong. Specifically, under the theme of "Mutual Accountability", it was often observed that some students, who usually sit together spontaneously, form a specific learning group in their physical design studios. Within such learning groups, group members usually check each other's design process and provide suggestions.

Specifically, as shown in Field Notes 3.1.2-2, 14.30-16.00, 15th-18th May, Sunday-Wednesday 2022:

> There were always three students sitting together in the middle of the 3rd-year studio for several hours in the afternoons, enabling a fixed peer learning group; Meantime, there was another fixed learning group, consisting of 2-3 students, tending to organise peer learning within the tutorial space.

Regardless of what students do within the design studio, they usually engaged in their learning groups within the design studio learning environment. For instance, Figure 20 **Error! Reference source not found.Error! Reference source not found.**illustrates the distribution of students in 1st-, 2nd-, and 3rd-year studios, respectively, from 15.00-15.30 on 3rd November, Thursday 2022, and the Field Notes 1.1.3-1 are shown below:

> That day was close to the deadline for 1st-year students to submit the assignment of Architectural Technology (AT1), so the number of present 1st-year students is the biggest among three academic years (each brown circle represents a person, and each light rectangle represents a long table), followed by 2nd-year and 3rd-year. It can be found that the "learning cluster" composed of different numbers of students are various, including individual learning, small group learning (2-4 people), and extensive group learning (6-8 people). In addition, whatever academic year, there are always 2 or 3 students sitting on their own and keeping a distance from others.

Compared with that, Figure 21 presents the distribution of students in all three academic years after 1st-year students submitting the final work of AT1, and the Field Notes 1.1.3-2, from 15.00-15.30 on 8th November, Tuesday 2022, are shown below:

> It is found that the number of first-year students presenting at the design studio decreased dramatically, even though they still need to submit the portfolio of Architectural Design soon. In contrast, the number of students in year two and year three does not change obviously, and students' seats are mostly maintained by themselves, which implies that those students' learning activities have been their daily routines rather than tasks.

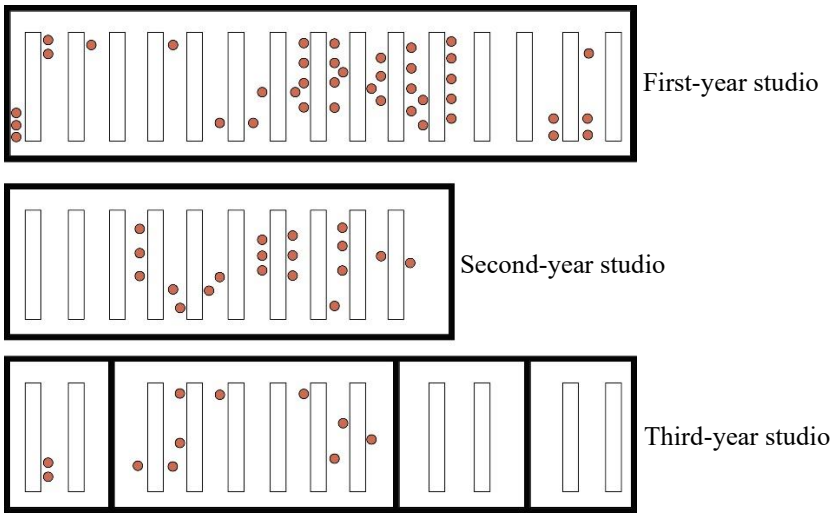

Figure 20 The Distribution of Students in Three Design Studios before the Deadline

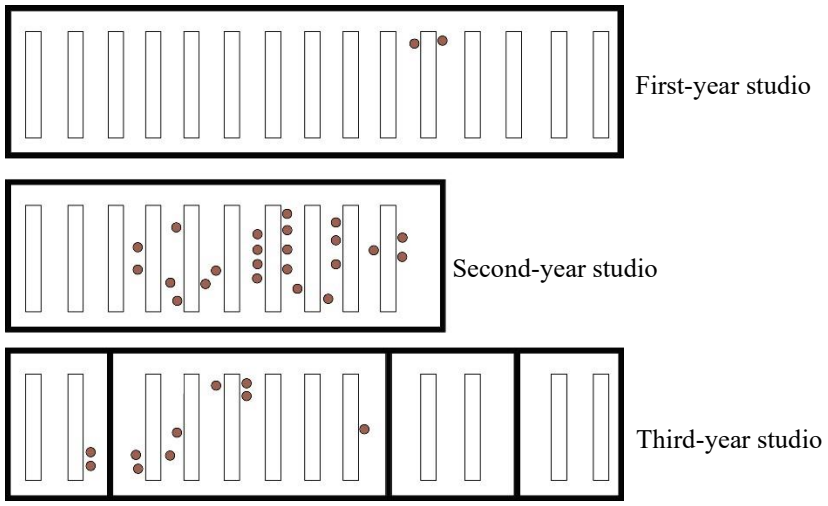

Figure 21 The Distribution of Students in Three Design Studios after the Deadline

It was found from observations above that many students had the tendency of working as a community due to the approaching deadline. For example, 1st-year students worked hard for the deadline of the AT1 assignment. As shown in Figure 20, many of them worked together as the form of several learning clusters in their physical design studio, ensuring that they were not going wrong. It was also found that such learning clusters also occurs among students in the 2nd- and 3rd- academic years even though it is not approaching the deadline. For example, as shown in Figure 20 and Figure 21, several specific learning clusters appeared in almost the same locations within 2nd- and 3rd-year design studios.

The next two field notes elaborate on the details of two examples of students' informal learning between peers within the 3rd-year physical design studio. Specifically, Field

Notes 3.1.1-4 described a scene where students' self-organised peer interaction to deal with the assignment issues and allocate tasks to each member. Usually, some students in the same learning group choose a casual time to have a specific conversation to discuss the details of dealing with issues, and the students in Field Notes 3.1.1-4 were typical.

Field Notes 3.1.1-4, 11.10-12.10 24th Mar, Thursday 2022:

> Four students were sitting at one table in their year studio, all in a group. The studio was located on the 2nd floor, north of Bute Building [the school building of the Welsh School of Architecture]. The table was located in a corner of the studio. Initially, they allocated tasks for an architectural economy session. After that, they completed their own study individually. In the middle of the process, two of them gathered to talk about a specific issue they encountered, and the other two continued doing their own tasks and occasionally joined the talk. After a half-hour communication, they dismissed for their lunch.

Similarly, there is another similar scene of social learning but with only three to five attendees found in the 3rd-year design studio, which is recorded by Field Notes 3.1.4-2, 16.00-20.00 3rd May, Tuesday 2022:

> Three students sit around a table in the middle of the 3rd-year design studio from 4 pm. During the process, they primarily dealt with their own design projects with headphones, so they were not disturbed even though there were loud communications. One of them was watching videos and doing design work simultaneously. Sometimes, one student asked for help from another opposite her. Two other students came to them to talk about extending the deadline for submitting the portfolio from 6.40-6.50 pm. One student went to pick up food delivery for them three at 7.30 pm. During the dinner, they communicate to talk about their everyday lives rather than their design projects. Another student joined their communication till 8 pm.

Compared to the design studio learning environment in physical design studios, tutorial space in the school building also provided some students with the design studio learning environment. To comprehend the differences of informal learning between peers within the design studio and tutorial space, one observation was conducted in the tutorial space. The descriptive information of this observation is detailed in Field Notes 3.2.4, 13.30-18.00 22nd Mar, Tuesday 2022:

> Two 3rd-year students were learning within a unit in the tutorial space. The unit, located in the middle of the tutorial space, was a semi-opened space with a table and a shared screen on the wall. Student F-Year 3 was making a

> SketchUp Model on his own computer, and Student B-Year 3 was attending his tutorial. After a half hour, the tutorial ended, and Student B-Year 3 went to another school building to have his lunch. When Student B-Year 3 came back, he began to search for resources online to support his design project, and he was still making digital models on SketchUp. That condition lasted till 15.30. During the process, Student B-Year 3 once asked some questions about design ideas and complimented the digital model made by Student F-Year 3. From 16.00, Student D-Year 3 attended the peer learning with Students B-Year 3 and Student F-Year 3. He was drawing CAD on his own laptop. Those three students were all doing their own learning and other tasks. At 17.00, Student B-Year 3 left first after finishing his digital model; Meanwhile, Students F-Year 3 and Student D-Year 3 returned to their year studio to be interviewed.

The observations above identifies that some students typically work together as different forms of learning clusters, checking each other's design projects, providing suggestions with each other, and ensuring not going wrong. Specifically, students, who usually engage in informal learning between peer within their physical design studios, are typically the members of some specific learning groups. Otherwise, students can also organise informal learning groups with random people in the tutorial space. Within these learning groups, some of them were organised after several attempts. For example, under the theme of "Negotiate Enterprise", it was observed that if there were courses or tutorials within the tutorial space, it was easy for students in other academic years to be disturbed. Therefore, there are typically tutorials and a few students from other academic years who learn in separate units within the tutorial space simultaneously during weekdays, while the tutorials indirectly negatively affect those students' independent learning experiences. In other words, it is because of the "formal" learning environment within the tutorial space when tutorials occur. For example, there was an observation, as shown in Field Notes 3.2.2, 13.30-14.30, 12th May, Thursday 2022:

> It was the day of the 2nd-year's desk crit. Dring the process of crit, 3rd-year students who normally did informal learning in the tutorial space did not present. Even though, there were still two students in other academic years doing individual learning in an unoccupied unit, and they did not have interactions during that period. The voices from the crit made the tutorial

> space loud, but those two students still insisted on learning in such environment.

It is known from observations above that many students get used to engaging in informal learning with specific people as the form of learning groups within the design studio learning environment of physical design studios and the tutorial space. Nevertheless, since there are several learning groups within these spaces, engagements between each learning group are available. For example, even though some students organise their learning groups, they still need to ask for help from others when they meet tough issues which cannot be figured out. This process generated a new peer-to-peer engagement between students, which brought benefits to the original community of practice constituted by a learning group, as shown in Field Notes 1.1.1-1, 15.00-19.45, 28th April, Thursday 2022:

> As they [Student D, E, F, G-Year 1] worked, three of them discussed the questions posed by the assignment. They exchanged their perceptions on each specific issue they met. Occasionally, they paused to ponder over a particularly tricky problem and then pointed to others asking for help. At around 16.30, one of the three students who had been engaged in the discussion stood up abruptly. With a determined look on his face, he made his way towards a student outside this learning group, seeking additional help. The minutes ticked by as he conferred with the other student, asking questions. This lasted for a full half an hour, during which time the other two members of the group continued to work, occasionally looking up to see if their companion was on his way back. Finally, the student returned, a look of satisfaction on his face. He had clearly figured out the issue that had been troubling them and was eager to share his newfound knowledge with the other two members. He explained his solution clearly and patiently, and the others listened attentively, nodding in agreement and making notes.

It is known from the observation above that some students constituted their modes of informal learning between peers through attempting constituting novel peer-to-peer engagements with different individuals. It was also observed that some students, furthermore, shared the knowledge, which was acquired from engaging in novel peer-to-peer engagements within the physical design studio, with more students. For example, due to the virtual learning experiences during the pandemic, students mastered the use of

Miro as a hybrid space to share their learning materials, allowing others to access them, as shown in the Field Notes 3.1.3, 12.00-12.45, 16th Nov, Wednesday 2022:

> Student K-Year 3 presented his physical model and drawings to me in the 3rd-year design studio, and we talked about his design project for a while. He was inspired by my suggestions and made some notes on the Miro platform. I saw the materials of his design progress, including the drawings and SketchUp models, on the platform, just as I saw when he presented to me just now. He told me that many students uploaded their outcomes on Miro, and he could view theirs in the meanwhile. If someone does not normally study at the design studio, he/she could have a look at others' works on Miro, which means that this platform is regarded as an online design studio by students themselves.

It is known from the observation above that not every student has the capacity to adapt to the design studio learning environment in physical design studios as well as the tutorial space. The rationale that students engaged in informal learning between peers within their preferred design studio learning environments will be explored from interviews and focus groups in the next section.

5.4.2 Findings from Interviews and Focus Groups

Compared with the themes coded from data of observations, the data collected from interviews and focus groups indicate that there is generally more information of students' informal learning activities between peers. For example, Figure 22 illustrates the data collected from interviews and focus groups under the theme of a joint enterprise. Specifically, four characteristics of this theme were found, which are "Mutual Accountability", "Rhythms", "Negotiated Enterprise", and "Interpretation". Within these three characteristics, "Mutual Accountability", "Rhythms", and "Negotiated Enterprise" are explained in Section 5.4.1. In addition, "Interpretation" refers to the alternative design studio learning environment that some students constitute outside their design studios, such as using the Miro for sharing learning materials and design processes with others who usually do not study within their design studios. Accordingly, under the theme of "Mutual Accountability", it is found that "sweating" between students is regarded as their mutual accountability to motivate everyone's own learning, but it also generates pressures

to some students to some extent. Under the theme of “Rhythms”, it is found that some students have their daily routine of insisting on studying within the design studio learning environment of physical design studios. Under the themes of “Negotiated Enterprise”, it is found that although the design studio learning environment within physical design studios is significant for students to constitute communities of practice, some students do not regard it as their first choice for their communities of practice. Under the theme of “Interpretation”, it is found that some students constitute alternative design studio learning environments outside their physical design studios, such as tutorial spaces and non-timetabled spaces on campus, public spaces off campus, as well as their own home. It is noticeable that the cubes within the hatch Green rectangle on the right side of the coding diagram depicts an inductive process. Specifically, the collected data are firstly classified according to their common characteristics, and such characteristics are further coded into specific themes, which are ultimately coded into the final theme. Under the theme of a joint enterprise, accordingly, all sub-themes are coded into “a joint enterprise is ensured by design studio learning environment and its alternatives”. The related data regarding these four characteristics are elaborated below.

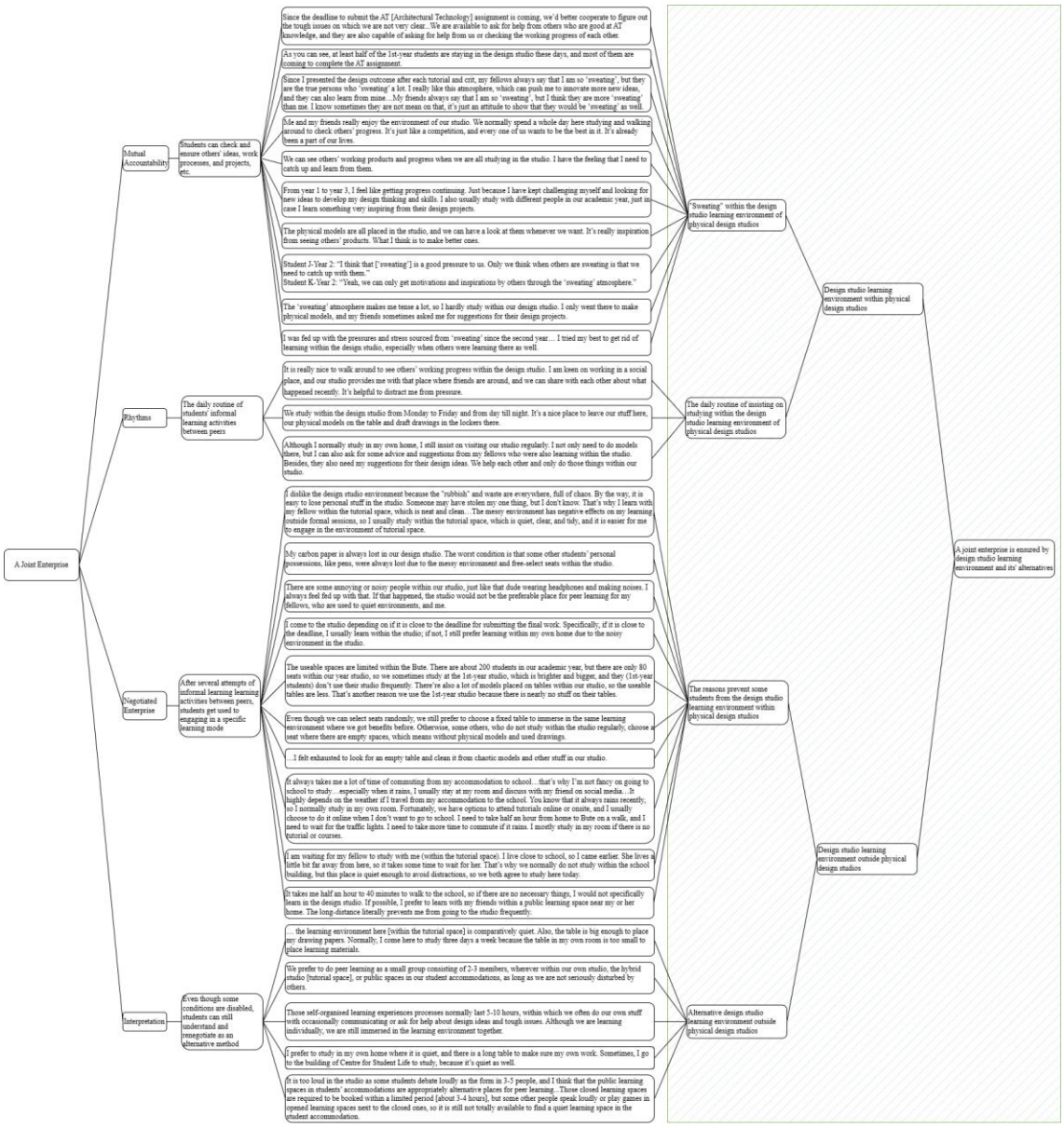

Figure 22 The Thematic Map of A Joint Enterprise Collected from Interviews and Focus Groups

Under the theme of "Mutual Accountability", it is known that the majority of the students accept and immerse themselves in the "sweating" atmosphere within the design studio. For example, some interviewees indicated:

> *Student H-Year 2: "Me and my friends really enjoy the environment of our studio. We normally spend a whole day here studying and walking around to check others' progress. It's just like a competition, and every one of us wants to be the best in it. It's already been a part of our lives."*
> *Student K-Year 2: "We can see others' working products and progress when we are all studying in the studio. I have the feeling that I need to catch up and learn from them."*

Student L-Year 2: "The physical models are all placed in the studio, and we can have a look at them whenever we want. It's really inspiration from seeing others' products. What I think is to make better ones."
Student K-Year 3: "Since I presented the design outcome after each tutorial and crit, my fellows always say that I am so 'sweating', but they are the true persons who 'sweating' a lot. I really like this atmosphere, which can push me to innovate more new ideas, and they can also learn from mine…My friends always say that I am so 'sweating', but I think they are more 'sweating' than me. I know sometimes they are not mean on that, it's just an attitude to show that they would be 'sweating' as well."
Student F-Year 3: "From year 1 to year 3, I feel like getting progress continuing. Just because I have kept challenging myself and looking for new ideas to develop my design thinking and skills. I also usually study with different people in our academic year, just in case I learn something very inspiring from their design projects. At present, I even confirm my future design topics, which is rural revitalisation. I decided on this aim when I was in year 2, but many others were still just fighting for higher scores at that time."

Student J-Year 2 and Student K-Year 2, as the form of Focus Group 2.1.2-2, both agreed that the surrounding environment where students are around within the design studio is a motivation for their own learning, indicating:

Student J-Year 2: "I think that ['sweating'] is a good pressure to us. Only we think when others are sweating is that we need to catch up with them."
Student K-Year 2: "Yeah, we can only get motivations and inspirations by others through the 'sweating' atmosphere."

Likewise, many 1st-year students once studied within their physical design studio when the deadline of AT1 assignment was approaching, ensuring a good score of their assignment. For instance, Student C-Year 1 and Student D-Year 1 all indicated:

Student C-Year 1: "Since the deadline to submit the AT [Architectural Technology] assignment is coming, we'd better cooperate to figure out the tough issues on which we are not very clear… We are available to ask for help from others who are good at AT knowledge, and they are also capable of asking for help from us or checking the working progress of each other."
Student D-Year 1: "As you can see, at least half of the 1st-year students are staying in the design studio these days, and most of them are coming to complete the AT assignment."

It can be revealed from students' accounts above that "sweating" refers to an unconscious competition between architecture students only when they observe others' work processes.

In other words, some students regard "sweating" as their pressure to study architecture. For example, some interviewees complained:

> *Student E-Year 2: "The 'sweating' atmosphere makes me tense a lot, so I hardly study within our design studio. I only went there to make physical models, and my friends sometimes asked me for suggestions for their design projects."*
> *Student A-Year 3: "I was fed up with the pressures and stress sourced from 'sweating' since the second year… I tried my best to get rid of learning within the design studio, especially when others were learning there as well."*

Under the theme of "Rhythms", students' responses from the interview illustrate the significance of the design studio learning environment for their informal learning activities between peers, even though each individual works on their own tasks. For example, many participants provided details about their learning activities within the design studio learning environment, indicating the significance of the design studio learning environment within physical design studios.

> *Student H-Year 2: "It is really nice to walk around to see others' working progress within the design studio. I am keen on working in a social place, and our studio provides me with that place where friends are around, and we can share with each other about what happened recently. It's helpful to distract me from pressure."*
> *Student J-Year 2: "We study within the design studio from Monday to Friday and from day till night. It's a nice place to leave our stuff here, our physical models on the table and draft drawings in the lockers there."*
> *Student E-Year 2: "Although I normally study in my own home, I still insist on visiting our studio regularly. I not only need to do models there, but I can also ask for some advice and suggestions from my fellows who were also learning within the studio. Besides, they also need my suggestions for their design ideas. We help each other and only do those things within our studio."*

However, the design studio learning environment in physical design studios is not the only choice for architecture students to engage in informal learning between peers. Specifically, under the theme of "Negotiated Enterprise", some study participants found alternative ways to engage in informal learning between peers outside physical design studios, since they had been affected by the design studio learning environment within physical design studios after several learning experiences within it. For example, **Error! Reference source not found.** depicts a "messy" environment within the 3rd-year physical

design studio, which is crammed with group models, drawings, and pin-ups, signifying the group work and shared learning materials produced here. Some students expressed their dissatisfactions to the "messy" environment within this physical design studio:

> *Student A-Year 3: "I dislike the design studio environment because the 'rubbish' and waste are everywhere, full of chaos. By the way, it is easy to lose personal stuff in the studio. Someone may have stolen my one thing, but I don't know. That's why I learn with my fellow within the tutorial space, which is neat and clean…The messy environment has negative effects on my learning outside formal sessions, so I usually study within the tutorial space, which is quiet, clear, and tidy, and it is easier for me to engage in the environment of tutorial space."*
>
> *Student F-Year 3: "My carbon paper is always lost in our design studio. The worst condition is that some other students' personal possessions, like pens, were always lost due to the messy environment and free-select seats within the studio."*
>
> *Student F-Year 3: "There are some annoying or noisy people within our studio, just like that dude wearing headphones and making noises. I always feel fed up with that. If that happened, the studio would not be the preferable place for peer learning for my fellows, who are used to quiet environments, and me."*
>
> *Student H-Year 3: "I come to the studio depending on if it is close to the deadline for submitting the final work. Specifically, if it is close to the deadline, I usually learn within the studio; if not, I still prefer learning within my own home due to the noisy environment in the studio."*

Figure 23 The "Messy" Environment within the Design Studio (Taken by Jierui Wang)

Likewise, some students from other academic years also dislikes the design studio learning environment within their physical design studio, arguing:

> *Student I -Year 2: "I really like learning within a tidy environment, so I don't like the working environment within the design studio. People are always*

talking, and the messy environment distracts me from my work. I came to the studio today because I need to do my practical stuff, my physical model, as you can see. Otherwise, I only come here when there are tutorials or other courses."

Student L-Year 2: "I am easily distracted by talking to people around, and I think it's a waste of my time on my own work. I came to the studio today because there will be a submission tomorrow, so I need to talk with my group members about our group model here."

Besides the "messy" environment within physical design studios influencing students' willingness to study in them, the lack of learning spaces in physical design studios is also a significant issue. For instance, some students complained that when they arrived at their design studio, the individuals who frequently study within the design studio sit on their "own seats" and put their physical models and drawing papers elsewhere. In contrast, others needed to move away these models and drawings to clear up a clean seat to sit. As indicated by these interviewees:

Student G-Year 2: "The useable spaces are limited within the Bute. There are about 200 students in our academic year, but there are only 80 seats within our year studio, so we sometimes study at the 1st-year studio, which is brighter and bigger, and they [1st-year students] don't use their studio frequently. There're also a lot of models placed on tables within our studio, so the useable tables are less. That's another reason we use the 1st-year studio because there is nearly no stuff on their tables."

Student J-Year 3: "...I felt exhausted to look for an empty table and clean it from chaotic models and other stuff in our studio."

Student F-Year 3: "We have to arrive at the studio early to find a preferable seat, especially during the winter."

Student D-Year 3: "...because those seats are closer to the radiator to keep us warm."

Student D-Year 2: "Even though we can select seats randomly, we still prefer to choose a fixed table to immerse in the same learning environment where we got benefits before. Otherwise, some others, who do not study within the studio regularly, choose a seat where there are empty spaces, which means without physical models and used drawings."

Another crucial factor hindering students from studying within the design studio is commuting time. In interviews responses, many students expressed their unwillingness to waste time commuting. For example, some interviewees complained about the

commuting time from their home to school, which would waste time for completing their assignments and design projects on time, as shown below.

> *Student G-Year 2: "It always takes me a lot of time of commuting from my accommodation to school…that's why I'm not fancy on going to school to study…especially when it rains, I usually stay at my room and discuss with my friend on social media…It highly depends on the weather if I travel from my accommodation to the school. You know that it always rains recently, so I normally study in my own room. Fortunately, we have options to attend tutorials online or onsite, and I usually choose to do it online when I don't want to go to school. I need to take half an hour from home to Bute on a walk, and I need to wait for the traffic lights. I need to take more time to commute if it rains. I mostly study in my room if there is no tutorial or courses."*
> *Student E-Year 3: "I am waiting for my fellow to study with me (within the tutorial space). I live close to school, so I came earlier. She lives a little bit far away from here, so it takes some time to wait for her. That's why we normally do not study within the school building, but this place is quiet enough to avoid distractions, so we both agree to study here today."*
> *Student C-Year 3: "It takes me half an hour to 40 minutes to walk to the school, so if there are no necessary things, I would not specifically learn in the design studio. If possible, I prefer to learn with my friends within a public learning space near my or her home. The long-distance literally prevents me from going to the studio frequently."*

All the students' accounts above imply that not every student regards the design studio learning environment within physical design studios as the first choice for their communities of practice. Therefore, some students found their own ways to constitute an alike design studio learning environment outside physical design studios. For example, under the theme of "Interpretation", there is a shared learning place – the tutorial space, where some students prefer to study. Those students who learn within the tutorial space have relatively independent learning spaces, which are not easily influenced by their surroundings. If there are no tutorials or other non-study related activities within the tutorial space, this space is usually chosen by some students who prefer a quiet learning environment. For example, as the statement by some interviewees:

> *Student J-Year 1: "… the learning environment here [within the tutorial space] is comparatively quiet. Also, the table is big enough to place my drawing papers. Normally, I come here to study three days a week because the table in my own room is too small to place learning materials."*

Student F-Year 3: "We prefer to do peer learning as a small group consisting of 2-3 members, wherever within our own studio, the hybrid studio [tutorial space], or public spaces in our student accommodations, as long as we are not seriously disturbed by others."
Student B-Year 3: "Those self-organised learning experiences processes normally last 5-10 hours, within which we often do our own stuff with occasionally communicating or ask for help about design ideas and tough issues. Although we are learning individually, we are still immersed in the learning environment together."

Despite the tutorial space ensuring an alike design studio learning environment, some other students have alternatively explored unique learning places to sustain their daily learning experiences. For example, some students claimed that their own room was their preferred study space, as indicated by interviewees below:

Student I-Year 2: "I prefer to study in my own home where it is quiet, and there is a long table to make sure my own work…sometimes, I go to the building of Centre for Student Life [another school facility of Cardiff University] to study, because it's quiet as well."
Student L-Year 2: "I usually study in my own room to avoid the distractive stuff around me. When my flatmate wants to learn with me together, we sometimes go to the public space in our accommodation because there are some specific spaces for small group learning."
Student A-Year 3: "…having a proper work setup in my room: for example, by having two desks - one for drawing/model-making and the other for the computer… when I would work with other flatmates for group work in earlier smaller models in 3rd year… I think providing further opportunity for lots more studio spaces to be made available with ease…would also be helpful".
Student G-Year 3: "I normally prefer staying in my own room to study due to the all-settled facilities, such as high-level computers, multiple screens, work desks, and a comfortable gaming chair. I can use different architectural design applications simultaneously without being stuck and use them on different screens, which is productive for my design process. Compared with working with my low-productive lap-top and mussy environment within the studio, the learning efficiency and mood are absolutely better."

Besides students' own rooms, some public learning spaces within student accommodations are also an alternative place to constitute an alike design studio learning environment. **Error! Reference source not found.** showcases some representative public learning spaces within the student accommodation, including opened, semi-opened, and enclosed spaces.

Student A-Year 3: "I think that the public learning spaces in students' accommodations are appropriately alternative places for peer learning…Those closed learning spaces are required to be booked within a limited period [about 3-4 hours], but some other people speak loudly or play games in opened learning spaces next to the closed ones, so it is still not totally available to find a quiet learning space in the student accommodation."

Figure 24 Typical Public Learning Spaces within the Students' Accommodation (Taken by Xueying Wang)

In summary, wherever in the design studios in the school building or the self-organised studio in students' accommodation, most architecture students usually maintain the design studio learning environment.

5.4.3 A Joint Enterprise is Ensured by the Design Studio Learning Environment and Its Alternatives

In summary, although there are no obvious differences of final themes between these two datasets, the themes generated by the data from interviews and focus groups not only identified but also supplied those from observations. For example, under the theme of a joint enterprise, data collected from interviews and focus groups depicted not only various learning and non-study related activities within design studio learning environment within and outside physical design studios, but they also revealed the reasons why some students do not enjoy the design studio learning environment within physical design studios.

It is evident from the findings above that, within physical design studios, architecture students are engaged in the design studio learning environment where they have multiple sources, including shared learning materials and other learning individuals, to assist their

own learning. Thus, apart from formal sessions, desk crits, and tutorials, students can also undertake other learning and non-study related activities within physical design studios outside formal timetable activities.

However, not all students regard the design studio learning environment within physical designs studios as the core element for their informal learning. My thesis finds that there are four main reasons leading to this phenomenon. Firstly, it can be seen from students' accounts in the last section that the design studio learning environment generates the "sweating", which is a double-edged sword to architecture students' initiatives to some extent. Some students regard it as the motivation to enable them work hard, whereas some others regard it as the pressure to make them get rid of it. The second reason is that some of these students dislike the "messy" environment where others distract them. As long as there are sufficient spaces in their rooms to hold their learning materials, such as sketch papers and big computer screens, they tend to keep learning in the quiet and clean learning environments to avoid the "messy" environment where there are peoples' talking and walking around, and physical models placed randomly everywhere. The third one is that some of these students were influenced by the external factors, such as the commuting time from their home to school and weather conditions, so they could stay at home and contact with others by social media or other synchronous communications. The last one is typically caused by side effects of a whole year's virtual learning in remote ways. Since some specific online design studio learning environments, such as Miro, have been developed during the COVID-19 period, students can share their learning materials, design ideas, and design processes with others via these online environments. These environments have replaced the physical design studio to some extent, which get rid of the bad effects brought by "messy" environment when engage in face-to-face informal learning between peers and commuting time from home to school.

Nevertheless, many students still regard the design studio learning environment as the core component of their own learning when they work outside physical design studios. Even if they work from home, they still insist on constituting a similar design studio

learning environment as within physical design studios. Some architecture students living in a shared accommodation even create a physical environment resembling the design studio learning environment of physical design studios, such as long tables, shared models and drawings, projectors, and a messy environment. For example, as indicated by the 2nd-Year Chair:

> *2nd-Year Chair: "Around ten architecture students living in the same house, mostly 2nd- and 3rd-year. They normally learn with each other within the living room, organising an environment just like a design studio."*

Accordingly, the design studio learning environment and its alternatives allow students to form various of communities of practices. Specifically, within physical design studios, students typically focus on their own tasks and occasionally interact with others, organising a large-scale learning community with messy and noisy environments. In contrast, outside physical design studios, students typically self-organise alternative design studio learning environments in the form of small-scale learning groups within comparatively quiet and clean environments, such as the tutorial space.

5.5 Summary: The Ways that Students' Informal Learning between Peers Constitutes the Community of Practice

This chapter presents the initial findings from the second-phase study, addressing the second objective "to classify these modes of informal learning and to identify what characteristics they have". By analysing volunteered architecture students' informal learning experiences between peers in the Welsh School of Architecture, this chapter summarises specific ways that the informal learning between peers constitutes the community of practice. The last three sections elaborate on the data analysis from the second-phase study. Specifically, based on thematic analysis, field notes of observations and transcripts of interviews and focus groups were encoded into different themes via the lens of the attributes of the community of practice, including a shared repertoire, mutual engagement, and a joint enterprise. For example:

- Participants typically organised informal learning between peers in three forms. Specifically, one is actively organised by 2-8 individuals, another is passively immersed in multiple, normally more than 8 individuals, and the last one is organised by individuals who have no specific preferences on learning modes and build the connection between these modes. Consequently, the design studio learning environment and various peer-to-peer engagements between students form different forms of a shared repertoire. This characteristic is encoded into the theme “A shared repertoire of is sourced from different forms of communities of practice”.
- Participants maintain peer-to-peer engagements with peers by mainly two measures, either face-to-face communications within physical spaces, or distance ways via social media or virtual platforms. As a result, these two contact methods generate different mutual engagements among students. This characteristic is regarded as the theme “Mutual engagement is generated by different contact methods”.
- Participants had preferred learning environments, mainly within design studios or outside it. Specifically, many students regard the design studio learning environment within their physical design studios as the core space for their learning and non-study related activities outside formal timetable. By contrast, other students dislike the messy and noisy environment within their physical design studios, so they preferred informal learning between peers within relatively quiet spaces, such as the tutorial space and their own homes. Even so, they still constitute a similar design studio learning environment within such spaces. Consequently, the design studio learning environment form a joint enterprise. This characteristic is encoded into the theme “A joint enterprise is ensured by design studio learning environment and its alternatives”.

According to data analysis from the second-phase study, the final themes of data regarding “A Shared Repertoire” were encoded as “Different Forms of Communities of

Practice"; the final themes of data regarding "Mutual Engagement" were coded as "Different Contact Methods"; the final themes of data regarding "A Joint Enterprise" were coded as "Design Studio Learning Environment and Its Alternatives". The next three sections will elaborate on the findings on these themes. The thematic map that consists of quotations, key-wards, original coding, initial themes, are illustrated in the last two sections. Table 15 illustrates the final themes and the specific indication of these themes.

Table 15 Final Themes of Collected Data from the Second-Phase Study

Themes	A Shared Repertoire is Sourced from Different Forms of Communities of Practice	Mutual Engagement is Generated from Different Contact Methods	A Joint Enterprise is Ensured by the Design studio learning environment and its alternatives
Specific indication	Students engage in informal learning between peers as different forms of communities of practice, which are mostly based on students' peer-to-peer engagements which are sources from common interests, traits, concerns, values, aims, etc.	Students' interactions, such as communications, cooperation, competitions, and helping and getting help from others.	The design studio learning environment refers to physical settings and informal learning activities that happened amongst students within physical design studios. Its alternatives refer to self-constitute alike design studio learning environment outside physical design studios.

Specifically, study participants in this thesis typically organised informal learning activities in three main forms, which are learning groups in a small scale, learning communities in a large scale, and learning guerillas in no specific scales. Typically, a small-scale learning group (normally 2-8 individuals) is organised by close friends and/or specific study companions, while a large-scale learning community (normally 15-20 individuals) is maintained by random individuals, but a no-specific-scale learning guerilla is formed by some individuals who join learning groups or a learning community whatever they like. Peer-to-peer engagements maintain the connections of members in the community of practice, and these connections generate a shared repertoire; Face-to-face and distance contacts generate different effects on the constitution of the community of practice, and these contact methods generate mutual engagement; Design studio learning environment and its alternatives ensure the diversity of the community of practice, and this diversity generates a joint enterprise. Architecture students' informal learning between peers are all maintained and enhanced by specific contexts, mainly

represented by the design studio learning environment and the activities within it. Only in this way can the community of practice formed by architecture students' informal learning between peers be successful. Even in the virtual environment, although some students' basic learning feelings, such as productive, confident, and creative, have not been affected by the lack of specific physical contexts, architectural institutions have made efforts to maintain the non-study related interactions as within the design studio learning environment.

- A learning group is not specifically defined. It was found that group members of a learning group can contact each other through face-to-face and/or distance methods simultaneously, and such members are usually in good relationships or have common interests, concerns, ethics, etc. Typically, students organise learning groups with individuals who have built peer-to-peer engagements, and those groups can occur in any spaces, including the design studio, non-timetabled spaces outside physical design studios (such as non-timetabled learning spaces in other university institutions and public spaces in student accommodations), and even their own home, in remote contact methods. During the learning process, students generally focus on their own tasks and interact with each other occasionally.
- In contrast, a learning community typically occurs within the physical design studio, with many students studying within it. Within the context, for example, students can maintain their peer-to-peer engagements with peers by keeping the rhythm of typically working on their own tasks and occasionally walking around to check others' design projects. Generally, students in such form of learning community have soft connections between each other, and they can seek help and communicate with each other at any time and place within the design studio learning environment. It would be beneficial to have a shared platform or place to showcase all students' design processes and projects, so that they can have more opportunities to witness others' design ideas and thinking. The design studio learning environment within the physical design studio typically offers students this shared place. However, due to a

whole year of virtual learning during the "work from home" period in the COVID-19 pandemic, the design studio learning environment, where architecture students were used to, were taken away. Thus, the adverse effects still existed during my investigation, even though students were encouraged to study at the design studio. For example, many students insisted on engaging in informal learning only with their close friends or other members of the same design group. Even so, most of their learning time was maintained by seeking help and discussing general issues through distance contact methods. To solve this issue, social activities organised by the school and student associations provide students with opportunities to meet others with mutual interests, values, and experiences, generating peer-to-peer engagements.

- Comparatively, the form of learning guerillas is more freely organised by some students who typically have no specific preferences on choosing the learning spaces. These students not only have specific friends and study companions studying in small-scale groups, but they also enjoy the design studio learning environments of a large-scale community, so they typically join several learning groups or a learning community whatever they like. Generally, these students also act as the role of building peer-to-peer engagements through bridging learning groups and learning communities, so their informal learning experiences can generally form a shared repertoire in many genres. They can contact their friends and study companions through both face-to-face and distance methods, generating many possibilities of mutual engagement. They can engage in the design studio learning environment whatever within the physical design studio, in other non-timetabled spaces, at home, or even in virtual environments, constituting a joint enterprise with several possibilities.

To have a clear view of informal learning modes in different academic years and the ways that communities of practice develop throughout academic years, the next chapter will further subdivide these characteristics based on students' academic years.

CHAPTER SIX

How Communities of Practice Develop throughout Three Academic Years

6.1 Introduction

This chapter presents the manners in which communities of practice evolve based on architecture students' informal learning between peers outside their formal timetable activities, classified by the academic years of undergraduate students at the Welsh School of Architecture. Specifically, this chapter conducts a comparison of informal learning experiences among undergraduate architecture students of three different academic years. The results addressed the third objective, uncovering the development of communities of practice formed by informal learning experiences among architecture students of different academic years.

This chapter is organised into following sections: The following three sections detail the characteristics of three academic years' architecture students' informal learning experiences based on three attributes of communities of practice, which are a shared repertoire, mutual engagement, and a joint enterprise. This chapter concludes by presenting a summary of the thematic modes of communities of practice relying on the informal learning between peers of three academic years.

6.2 A Shared Repertoire

This section presents the findings of informal learning activities and the perceptions regarding them from 1st-, 2nd-, and 3rd-year students respectively, under the theme of "A Shared Repertoire".

6.2.1 Findings from Observations

Figure 25 illustrates the dataset of observations regarding the theme of "A Shared Repertoire" in three academic years. Specifically, it was found that only two sub-themes "Actions" and "Tools" manifested distinct characteristics in 1st-, 2nd-, and 3rd-year

students respectively. It is noticeable that the cubes within the hatch Green rectangle on the right side of the coding diagram depicts an inductive process, referring to the common characteristics of collected data regarding each academic year' informal learning between peers.

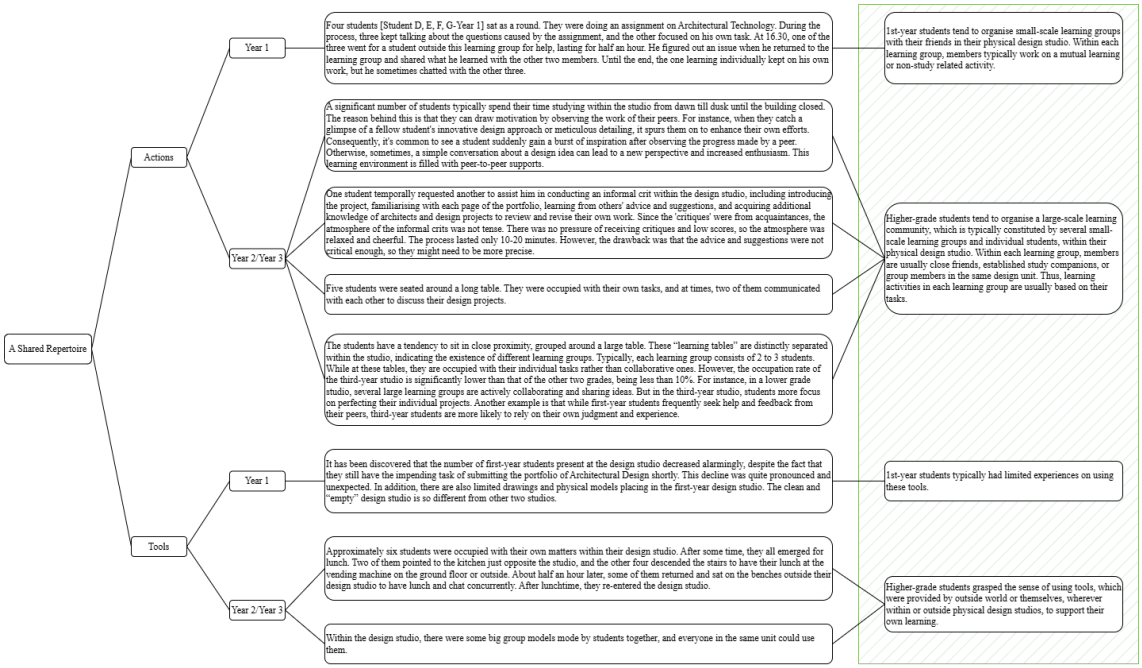

Figure 25 Data Collected from Observations Regarding A Shared Repertoire in Three Academic Years

Under the theme of "Actions". It was observed that 1st-year students hardly study within their physical design studio except the days approaching the deadline for submitting AT1 assignment. For example, four 1st-year students were observed for more than four hours in one afternoon before the deadline of submitting AT1 assignment, and the details are presented in the Field Notes 1.1.1-1, 15.00-19.45, 28th April, Thursday 2022:

> Four students [Student D, E, F, G-Year 1] sat as a round. They were doing an assignment on Architectural Technology. During the process, three kept talking about the questions caused by the assignment, and the other focused on his own task. At 16.30, one of the three went for a student outside this learning group for help, lasting for half an hour. He figured out an issue when he returned to the learning group and shared what he learned with the other two members. Until the end, the one learning individually kept on his own work, but he sometimes chatted with the other three.

Comparatively, it was observed that 2nd-year architecture students usually spend a prolonged period to engage in informal learning between peers within their physical

design studio, constituting a design studio learning environment. During the process, they not only work on their own learning and non-study related tasks, but they also walk around within their physical design studio, to check others' design process, as shown in Field Notes 2.1.2, 13.30-14.00, 4th May, Wednesday 2022:

> A significant number of students typically spend their time studying within the studio from dawn till dusk until the building closed. The reason behind this is that they can draw motivation by observing the work of their peers. For instance, when they catch a glimpse of a fellow student's innovative design approach or meticulous detailing, it spurs them on to enhance their own efforts. Consequently, it's common to see a student suddenly gain a burst of inspiration after observing the progress made by a peer. Otherwise, sometimes, a simple conversation about a design idea can lead to a new perspective and increased enthusiasm. This learning environment is filled with peer-to-peer supports.

Within such a design studio learning environment, students typically engaged in informal learning as the form of several "learning clusters". Within each learning cluster, students typically worked on their own learning and non-study related activities, and some of them also interacted, as shown in Field Notes 2.1.2, 13.30-14.00, 4th May, Wednesday 2022:

> Five students were seated around a long table. They were occupied with their own tasks, and at times, two of them communicated with each other to discuss their design projects.

It was also observed that some 2nd-year students usually actively engaged in informal learning activities with others in the learning cluster when they studied within their physical design studio. For example, as illustrated in Field Notes 2.1.1-2, 12.30-13.30 12th May, Thursday 2022:

> One student temporally requested another to assist him in conducting an informal crit within the design studio, including introducing the project, familiarising with each page of the portfolio, learning from others' advice and suggestions, and acquiring additional knowledge of architects and design projects to review and revise their own work. Since the 'critiques' were from acquaintances, the atmosphere of the informal crits was not tense. There was no pressure of receiving critiques and low scores, so the atmosphere was relaxed and cheerful. The process lasted only 10-20 minutes. However, the drawback was that the advice and suggestions were not critical enough, so they might need to be more precise.

Accordingly, it was found from observations that students' informal learning modes have distinct differences in higher grades and lower grades, manifesting the increasing independence and specialisation as students' progress in their academic journey. For example, as shown in Field Notes 3.1.1-1, 13.00-15.00, 28th April, Thursday 2022:

> The students have a tendency to sit in close proximity, grouped around a large table. These "learning tables" are distinctly separated within the studio, indicating the existence of different learning groups. Typically, each learning group consists of 2 to 3 students. While at these tables, they are occupied with their individual tasks rather than collaborative ones. However, the occupation rate of the third-year studio is significantly lower than that of the other two grades, being less than 10%. For instance, in a lower grade studio, several large learning groups are actively collaborating and sharing ideas. But in the third-year studio, students more focus on perfecting their individual projects. Another example is that while first-year students frequently seek help and feedback from their peers, third-year students are more likely to rely on their own judgment and experience.

The observations above illustrate distinct actions when students in three academic years engage in informal learning between peers within physical design studios. Typically, 1st-year students tend to organise small-scale learning groups with their friends in their physical design studio. Within each learning group, members typically work on a mutual learning or non-study related activity. Comparatively, higher-grade students tend to organise a large-scale learning community, which is typically constituted by several small-scale learning groups and individual students, within their physical design studio. Within each learning group, members are usually close friends, established study companions, or group members in the same design unit. Thus, learning activities in each learning group are usually based on their tasks.

Under the theme "Tools", it was usually found from observations that higher-grade students tended to use learning- and living-supportive facilities, which were provided for students' prolonged learning within physical design studios. For example, as shown in Field Notes 2.1.3-1, 13.00-13.45, 21st May, Saturday 2022:

> Approximately six students were occupied with their own matters within their design studio. After some time, they all emerged for lunch. Two of them pointed to the kitchen just opposite the studio, and the other four descended

> the stairs to have their lunch at the vending machine on the ground floor or outside. About half an hour later, some of them returned and sat on the benches outside their design studio to have lunch and chat concurrently. After lunchtime, they re-entered the design studio.

In addition, there are also some shared learning materials, such as physical models, within physical design studios. It was usually observed that higher-grade students were more inclined to use these shared learning materials. Specifically, it was observed that 2nd-year architecture students typically undertook drawing and model-making within their physical design studio, leaving the draft or related materials on tables within their physical design studio. Thus, the design studio became a shared material source accessible to everyone, and students could access those resources effectively and efficiently. Figure 26 depicts a typical scene of the models and other design crafts left in the studio, indirectly implying the diverse design studio learning environment of 2nd-year students. For example, as shown in Field Notes 2.1.4, 13.00-15.00, 10th May, Tuesday 2022:

> Within the design studio, there were some big group models mode by students together, and everyone in the same unit could use them.

Figure 26 The Models and Design Crafts in the 2nd-Year Studio (taken by Jierui Wang)

Compared with higher-grade students' physical design studio, there were usually very limited shared learning materials within 1st-year physical design studio. For example, as shown in Field Notes 1.1.3-2, 15.00-15.30 on 8th November, Tuesday 2022:

> It has been discovered that the number of first-year students present at the design studio decreased alarmingly, despite the fact that they still have the impending task of submitting the portfolio of Architectural Design shortly. This decline was quite pronounced and unexpected. In addition, there are also

limited drawings and physical models placing in the first-year design studio. The clean and "empty" design studio is so different from other two studios.

It is found from observations above that, higher-grade students grasped the sense of using tools, which were provided by outside world or themselves, wherever within or outside physical design studios, to support their own learning. Comparatively, 1st-year students typically had limited experiences on using these tools.

6.2.2 Findings from Interviews and Focus Groups

Figure 27 illustrates the dataset of interviews and focus groups regarding the theme of "A Shared Repertoire" in three academic years. Specifically, except "Actions" and "Tools" manifesting distinct characteristics among three academic years, it was further found that other four sub-themes "Historical Events", "Stories", "Styles", and "Concepts" manifested distinct characteristics in 1st-, 2nd-, and 3rd-year students respectively. It is noticeable that the cubes within the hatch Green rectangle on the right side of the coding diagram depicts an inductive process, referring to the common characteristics of collected data regarding each academic year' informal learning between peers.

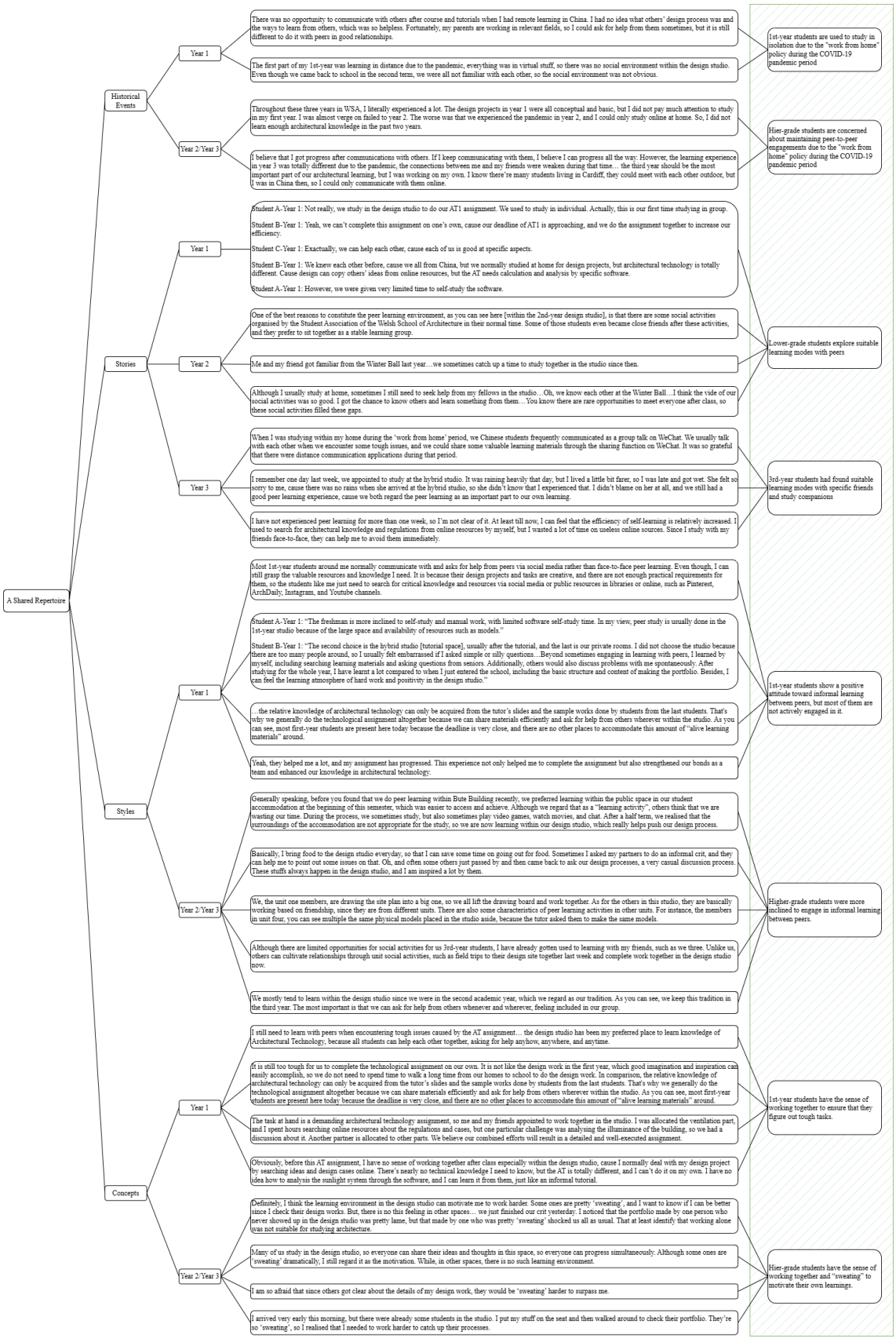

Figure 27 Data Collected from Interviews and Focus Groups Regarding A Shared Repertoire in Three Academic Years

Compared with the themes coded from data of observations, the data collected from interviews and focus groups indicate more comprehensive perspectives on constituting a shared repertoire wherever within or outside physical design studios. Specifically, under the theme of "Historical Events", it was known from interviews and focus groups that all students experienced "work from home" period during the COVID-19 pandemic, but students in different academic years showed distinct reactions to this period. For example, 1st-year students typically have nearly no experiences on engaging in informal learning between peers, as indicated by some interviewees below:

> *Student A-Year 1: "There was no opportunity to communicate with others after course and tutorials when I had remote learning in China. I had no idea what others' design process was and the ways to learn from others, which was so helpless. Fortunately, my parents are working in relevant fields, so I could ask for help from them sometimes, but it is still different to do it with peers in good relationships."*

It is found from accounts above that the first academic year is significant for architecture students to know each other and cultivate specific learning modes with others. However, a common historical event disabled them to build connections between peers when they were in lower grades. Comparatively, higher-grade students mainly expressed their concerns about maintaining their peer-to-peer engagements during that difficult period, since they have already built connections between friends or specific study companions. For example, as indicate by some higher-grade students:

> *Student E-Year 3: "Throughout these three years in WSA, I literally experienced a lot. The design projects in year 1 were all conceptual and basic, but I did not pay much attention to study in my first year. I was almost verge on failed to year 2. The worse was that we experienced the pandemic in year 2, and I could only study online at home. So, I did not learn enough architectural knowledge in the past two years."*
>
> *Student B-Graduated: "I believe that I got progress after communications with others. If I keep communicating with them, I believe I can progress all the way. However, the learning experience in year 3 was totally different due to the pandemic, the connections between me and my friends were weaken during that time… the third year should be the most important part of our architectural learning, but I was working on my own. I know there're many*

students living in Cardiff, they could meet with each other outdoor, but I was in China then, so I could only communicate with them online."

It is known from accounts above that, due to the "work from home" policy and distance learning modes in isolation, higher-grade students still have clearer views on specific learning methods, but these matters make lower-grade students not to know what to do. To solve such problems, students in different academic years provided distinct solutions. Specifically, under the theme of "Stories", lower-grade students, especially first-year ones, explored suitable learning modes by themselves. For example, some 1st-year students indicated that they had built peer-to-peer engagements with some study companions after several attempts of learning between peers, as indicated in Focus Group 1.1.1, 28th April, Thursday 2022:

Student A-Year 1: Not really, we study in the design studio to do our AT1 assignment. We used to study in individual. Actually, this is our first time studying in group.
Student B-Year 1: Yeah, we can't complete this assignment on one's own, cause our deadline of AT1 is approaching, and we do the assignment together to increase our efficiency.
Student C-Year 1: Exactually, we can help each other, cause each of us is good at specific aspects.
Student B-Year 1: We knew each other before, cause we all from China, but we normally studied at home for design projects, but architectural technology is totally different. Cause design can copy others' ideas from online resources, but the AT needs calculation and analysis by specific software.
Student A-Year 1: However, we were given very limited time to self-study the software.

Besides students building peer-to-peer engagements based on common race and interests after several attempts of learning between peers, some social activities, which were organised by SAWSA, were typically served as the opportunities for students to build peer-to-peer engagements. The attendances of these social activities are usually 2nd-year students, as the present of SAWSA is always acted by a 2nd-year student. For instance, Student E-Year 2 and Student F-Year 2 who attended both Winter Ball and Summer Ball, which are organised by SAWSA, emphasised the significance of such social activities for them to know others, in further to help them build peer-to-peer engagements:

Student D-Year 2: "One of the best reasons to constitute the peer learning environment, as you can see here [within the 2nd-year design studio], is that there are some social activities organised by the Student Association of the Welsh School of Architecture in their normal time. Some of those students even became close friends after these activities, and they prefer to sit together as a stable learning group."

Student E-Year 2: "Me and my friend got familiar from the Winter Ball last year…we sometimes catch up a time to study together in the studio since then."

Student F-Year 2: "Although I usually study at home, sometimes I still need to seek help from my fellows in the studio…Oh, we know each other at the Winter Ball…I think the vide of our social activities was so good. I got the chance to know others and learn something from them…You know there are rare opportunities to meet everyone after class, so these social activities filled these gaps."

Comparatively, after three years' learning, 3rd-year students have had more common experiences of learning and non-study related activities with peers. Thus, many of them were typically used to specific learning modes which were appropriate to them, and they usually engaged in informal learning with specific friends and study companions.

Student A-Year 3: "When I was studying within my home during the 'work from home' period, we Chinese students frequently communicated as a group talk on WeChat. We usually talk with each other when we encounter some tough issues, and we could share some valuable learning materials through the sharing function on WeChat. It was so grateful that there were distance communication applications during that period."

Student C-Year 3: "I remember one day last week, we appointed to study at the hybrid studio. It was raining heavily that day, but I lived a little bit farer, so I was late and got wet. She felt so sorry to me, cause there was no rains when she arrived at the hybrid studio, so she didn't know that I experienced that. I didn't blame on her at all, and we still had a good peer learning experience, cause we both regard the peer learning as an important part to our own learning."

Student E-Year 3: "I have not experienced peer learning for more than one week, so I'm not clear of it. At least till now, I can feel that the efficiency of self-learning is relatively increased. I used to search for architectural knowledge and regulations from online resources by myself, but I wasted a lot of time on useless online sources. Since I study with my friends face-to-face, they can help me to avoid them immediately."

It is known from students' accounts above that architecture students generally find their learning modes during the trajectory of their architectural learning, and they typically

engaged in informal learning between peers with specific friends and study companions. Specifically, under the theme of "Styles", it was found that students in the same academic years typically have mutual styles of informal learning between peers. For example, according to observations, it might require clarification on whether 1st-year students were keen on informal learning between peers within the design studio learning environment. Students' accounts from interviews and focus groups reveal it. Specifically, it was found from interviews and focus groups that 1st-year students showed a positive attitude toward informal learning between peers, but most of them were not actively engaged in it. Many of 1st-year students were just getting familiar with the discipline, learning model, and thinking style of architecture. Specifically, some of them indicated that their styles of informal learning between peers were mainly based on contacting with others in remote ways:

> *Student C-Year 1: "Most 1st-year students around me normally communicate with and asks for help from peers via social media rather than face-to-face peer learning. Even though, I can still grasp the valuable resources and knowledge I need. It is because their design projects and tasks are creative, and there are not enough practical requirements for them, so the students like me just need to search for critical knowledge and resources via social media or public resources in libraries or online, such as Pinterest, ArchDaily, Instagram, and Youtube channels."*

Likewise, as indicated in Focus Group 1.1.1, 28th April, Thursday 2022:

> *Student A-Year 1: "The freshman is more inclined to self-study and manual work, with limited software self-study time. In my view, peer study is usually done in the 1st-year studio because of the large space and availability of resources such as models."*
>
> *Student B-Year 1: "The second choice is the hybrid studio [tutorial space], usually after the tutorial, and the last is our private rooms. I did not choose the studio because there are too many people around, so I usually felt embarrassed if I asked simple or silly questions…Beyond sometimes engaging in learning with peers, I learned by myself, including searching learning materials and asking questions from seniors. Additionally, others would also discuss problems with me spontaneously. After studying for the whole year, I have learnt a lot compared to when I just entered the school, including the basic structure and content of making the portfolio. Besides, I*

can feel the learning atmosphere of hard work and positivity in the design studio."

Even though, some 1st-year students indicated that they still had to work with others face-to-face when they encountered some difficulties which were not available to figure out in individual, such as AT1 assignment. For example:

Student E-Year 1: "...the relative knowledge of architectural technology can only be acquired from the tutor's slides and the sample works done by students from the last students. That's why we generally do the technological assignment altogether because we can share materials efficiently and ask for help from others wherever within the studio. As you can see, most first-year students are present here today because the deadline is very close, and there are no other places to accommodate this amount of "alive learning materials" around."

Student G-Year 1: "Yeah, they helped me a lot, and my assignment has progressed. This experience not only helped me to complete the assignment but also strengthened our bonds as a team and enhanced our knowledge in architectural technology."

Different from most of 1st-year students who typically studied in individual and casually engaged in informal learning between peers to deal with tough tasks, higher-grade students were more inclined to engage in informal learning between peers. For example, according to interviews, some higher-grade students indicated that they engaged in distinct styles of informal learning between peers at different stages of design projects.

Student D-Year 3: "Generally speaking, before you found that we do peer learning within Bute Building recently, we preferred learning within the public space in our student accommodation at the beginning of this semester, which was easier to access and achieve. Although we regard that as a "learning activity", others think that we are wasting our time. During the process, we sometimes study, but also sometimes play video games, watch movies, and chat. After a half term, we realised that the surroundings of the accommodation are not appropriate for the study, so we are now learning within our design studio, which really helps push our design process."

Student H-Year 3: "Basically, I bring food to the design studio everyday, so that I can save some time on going out for food. Sometimes I asked my partners to do an informal crit, and they can help me to point out some issues on that. Oh, and often some others just passed by and then came back to ask our design processes, a very casual discussion process. These stuffs always happen in the design studio, and I am inspired a lot by them."

Some higher-grade interviewees supplemented different measures for students to engage in various informal learning activities, which were generating from peer-to-peer engagements between students:

> *Student M-Year 3: "We, the unit one members, are drawing the site plan into a big one, so we all lift the drawing board and work together. As for the others in this studio, they are basically working based on friendship, since they are from different units. There are also some characteristics of peer learning activities in other units. For instance, the members in unit four, you can see multiple the same physical models placed in the studio aside, because the tutor asked them to make the same models."*
>
> *Student M-Year 3: "Although there are limited opportunities for social activities for us 3rd-year students, I have already gotten used to learning with my friends, such as we three (as shown in Figure 28). Unlike us, others can cultivate relationships through unit social activities, such as field trips to their design site together last week and complete work together in the design studio now."*
>
> *Student K-Year 3: "We mostly tend to learn within the design studio since we were in the second academic year, which we regard as our tradition. As you can see, we keep this tradition in the third year. The most important is that we can ask for help from others whenever and wherever, feeling included in our group."*

Figure 28 Studying with Good Friends within the Same Design Studio (taken by Jierui Wang)

It is known from students' accounts above that, students had specific learning styles in different academic years. In the meanwhile, it was found from interviews and focus groups that students also generated specific concepts to support for their learning styles during the process of their informal learning between peers. For example, under the theme

of "Concepts", students in higher grades have the sense of working together and "sweating" to motivate their own learning.

> *Student A-Year 2: "Definitely, I think the learning environment in the design studio can motivate me to work harder. Some ones are pretty 'sweating', and I want to know if I can be better since I check their design works. But, there is no this feeling in other spaces…I noticed that the portfolio made by one person who never showed up in the design studio was pretty lame, but that made by one who was pretty 'sweating' shocked us all as usual. That at least identify that working alone was not suitable for studying architecture."*
> *Student B-Year 2: "Many of us study in the design studio, so everyone can share their ideas and thoughts in this space, so everyone can progress simultaneously. Although some ones are 'sweating' dramatically, I still regard it as the motivation. While, in other spaces, there is no such learning environment."*
> *Student C-Year 2: "Most of us 2nd-year students tend to study in our design studio. You can always see a lot of students studying in it in most cases. It has already been a mutual learning space. The learning environment motivates us a lot to 'sweating' a lot, but there's no this feeling studying in other places."*
> *Student A-Year 3: "I am so afraid that since others got clear about the details of my design work, they would be 'sweating' harder to surpass me."*
> *Student L-Year 3: "I arrived very early this morning, but there were already some students in the studio. I put my stuff on the seat and then walked around to check their portfolio. They're so 'sweating', so I realised that I needed to work harder to catch up their processes."*

Compared with these higher-grade students, many 1st-year students had limited sense of working together and "sweating" to motivate their own learning. Even though, they still had the sense of working together to ensure that they figure out tough tasks. For example, many 1st-year students realised the significance of working together when the deadline of submitting AT1 assignment was approaching, as indicated by some interviewees:

> *Student D-Year 1: "I still need to learn with peers when encountering tough issues caused by the AT assignment… the design studio has been my preferred place to learn knowledge of Architectural Technology, because all students can help each other together, asking for help anyhow, anywhere, and anytime."*
> *Student E-Year 1: "It is still too tough for us to complete the technological assignment on our own. It is not like the design work in the first year, which good imagination and inspiration can easily accomplish, so we do not need to spend time to walk a long time from our homes to school to do the design work. In comparison, the relative knowledge of architectural technology can*

only be acquired from the tutor's slides and the sample works done by students from the last students. That's why we generally do the technological assignment altogether because we can share materials efficiently and ask for help from others wherever within the studio. As you can see, most first-year students are present here today because the deadline is very close, and there are no other places to accommodate this amount of "alive learning materials" around."

Student F-Year 1: "The task at hand is a demanding architectural technology assignment, so me and my friends appointed to work together in the studio. I was allocated the ventilation part, and I spent hours searching online resources about the regulations and cases, but one particular challenge was analysing the illuminance of the building, so we had a discussion about it. Another partner is allocated to other parts. We believe our combined efforts will result in a detailed and well-executed assignment."

Student G-Year 1: "Obviously, before this AT assignment, I have no sense of working together after class especially within the design studio, cause I normally deal with my design project by searching ideas and design cases online. There's nearly no technical knowledge I need to know, but the AT is totally different, and I can't do it on my own. I have no idea how to analysis the sunlight system through the software, and I can learn it from them, just like an informal tutorial."

It is found from accounts above that 1st-year students typically have a shared concept of working together to complete the AT1 assignment, but they usually work in individual for design projects.

6.2.3 The Ways that A Shared Repertoire Develop throughout Three Academic Years

The data in the last two sections indicate that students in specific academic year also specifically generated a shared repertoire. Typically, 1st-year students are newcomers, meaning the majority of them might have never experienced the working mode within the design studio learning environment of physical design studios. Furthermore, the policy of "work from home" during the COVID-19 pandemic disabled this learning environment, but it rather enabled them to get used to learning in isolation and communicating with others by distance contact methods. These two conditions prevented 1st-year students from engaging in informal learning between peers within their physical design studio, as indicated by 1st-Year Chair:

> *1st-Year Chair: "Even though they [1st-year students] came back to school and were taught face-to-face during the second semester, there were still some rules to restrict students from using and sharing physical materials, models, and so on during the former few months of that term."*

Therefore, 1st-year students typically did not engage in informal learning between peers in physical design studios outside formal timetable activities. Nevertheless, many students worked with the study companions, who had common race and interests, before the deadlines of submitting some practical assignments. Additionally, some students also constituted communities of practice with friends as the form of small-scale learning groups outside physical design studios when there were no deadlines for submitting these assignments.

Comparatively, higher-grade students are typically more inclined to engage in informal learning between peers, since they have built peer-to-peer engagements with specific friends and study companions due to common habitus and social activities organised by SAWSA. Even though, 2nd-year and 3rd-year students still had distinct modes of informal learning. Specifically, 2nd-year students typically realised the significance of working together and "sweating" within the design studio learning environment of physical design studios, to motivate their own learning. Thus, many 2nd-year students typically engaged in informal learning between peers as the form of large-scale learning community.

Different from 2nd-year students, after three years' learning, many 3rd-year students not only have had specific study companions but also cultivated their learning styles with their study companions. For example, some 3rd-year students were typically inclined to engage in informal learning with specific friends, study companions, or group members as the form of several small-scale learning groups in their physical design studio before the deadline, and these learning groups further constituted a large-scale learning community. In addition, some other 3rd-year students typically tended to engage in informal learning between peers as the form of small-scale learning groups in other spaces outside their physical design studio, such as the tutorial space or other non-timetabled learning spaces on and off campus. Therefore, to meet the preferences of different

individuals for learning habitus, the 2nd-Year Chair indicated some available measures to satisfy all students' enthusiasm for informal learning between peers in physical design studios:

> *2nd-Year Chair: "There would be a rearrangement for the design studio, which is arranged by students' activities, such as self-learning, group learning, social learning, etc."*

6.3 Mutual Engagement

This section presents the findings of informal learning activities and the perceptions regarding them from 1st-, 2nd-, and 3rd-year students respectively, under the theme of "Mutual Engagement".

6.3.1 Findings from Observations

Figure 29 illustrates the dataset of observations regarding the theme of "Mutual Engagement" in three academic years. Specifically, it was found that two sub-themes "Social Complexity" and "Engaged Diversity" both manifested distinct characteristics in 1st-, 2nd-, and 3rd-year students respectively. It is noticeable that the cubes within the hatch Green rectangle on the right side of the coding diagram depicts an inductive process, referring to the common characteristics of collected data regarding each academic year' informal learning between peers.

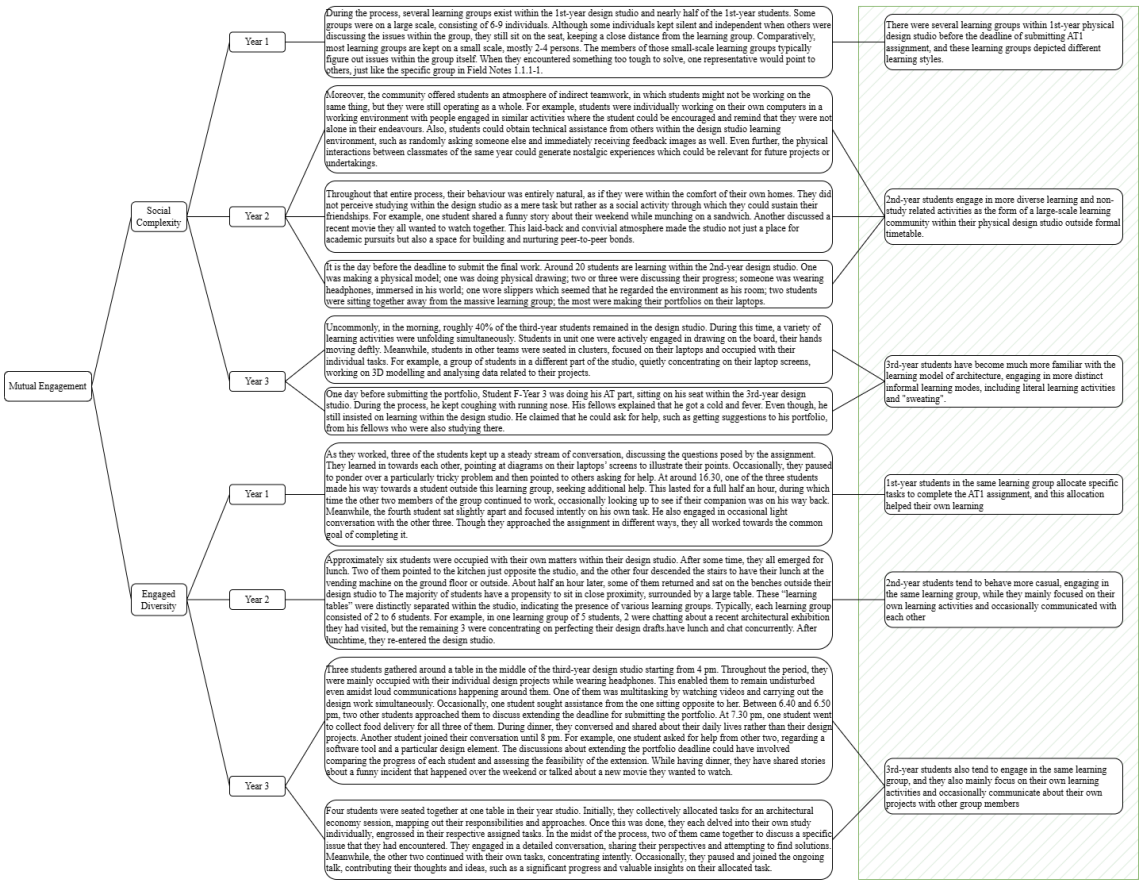

Figure 29 Data Collected from Observations Regarding Mutual Engagement in Three Academic Years

Under the theme of "Social Complexity", it was observed that there were several learning groups within the 1st-year physical design studio before the deadline of submitting AT1 assignment. These learning groups depicted different learning styles, as shown in Field Notes 1.1.1-2, 16.00-19.45, 28th April, Thursday 2022:

> During the process, several learning groups exist within the 1st-year design studio and nearly half of the 1st-year students. Some groups were on a large scale, consisting of 6-9 individuals. Although some individuals kept silent and independent when others were discussing the issues within the group, they still sit on the seat, keeping a close distance from the learning group. Comparatively, most learning groups are kept on a small scale, mostly 2-4 persons. The members of those small-scale learning groups typically figure out issues within the group itself. When they encountered something too tough to solve, one representative would point to others, just like the specific group in Field Notes 1.1.1-1.

Comparatively, 2nd-year students normally engaged in more diverse learning and non-study related activities within their physical design studio outside formal timetable. Due

to this design studio learning environment within the 2nd-year physical design studio, 2nd-year students usually engaged in informal learning between peers as the form of a large-scale learning community within their physical design studio. Within this learning community, students behave as in their normal lives, such as going out for lunch, watching videos, listening to music, chatting with peers, etc. For example, as shown in Field Notes 2.1.4, 13.00-15.00, 10th May, Tuesday 2022:

> Moreover, the community offered students an atmosphere of indirect teamwork, in which students might not be working on the same thing, but they were still operating as a whole. For example, students were individually working on their own computers in a working environment with people engaged in similar activities where the student could be encouraged and remind that they were not alone in their endeavours. Also, students could obtain technical assistance from others within the design studio learning environment, such as randomly asking someone else and immediately receiving feedback images as well. Even further, the physical interactions between classmates of the same year could generate nostalgic experiences which could be relevant for future projects or undertakings.

Likewise, as shown in Field Notes 2.1.3-1, 13.00-13.45, 21st May, Saturday 2022:

> Throughout that entire process, their behaviour was entirely natural, as if they were within the comfort of their own homes. They did not perceive studying within the design studio as a mere task but rather as a social activity through which they could sustain their friendships. For example, one student shared a funny story about their weekend while munching on a sandwich. Another discussed a recent movie they all wanted to watch together. This laid-back and convivial atmosphere made the studio not just a place for academic pursuits but also a space for building and nurturing peer-to-peer bonds.

Besides, as shown in Field Notes 2.1.3-2, 13.00-15.30, 10th May, Tuesday 2022 are presented below.

> It is the day before the deadline to submit the final work. Around 20 students are learning within the 2nd-year design studio. One was making a physical model; one was doing physical drawing; two or three were discussing their progress; someone was wearing headphones, immersed in his world; one wore slippers which seemed that he regarded the environment as his room; two students were sitting together away from the massive learning group; the most were making their portfolios on their laptops.

Furthermore, after three years of learning, 3rd-year students have become much more familiar with architectural learning, engaging in more distinct informal learning modes

between peers among different academic years. For example, 3rd-year students typically organised several learning groups and engaged in diverse informal learning activities between peers within the same physical design studio, as shown in Field Notes 3.1.1-3, 11.00-13.15, 16th Nov, Wednesday 2022:

> Uncommonly, in the morning, roughly 40% of the third-year students remained in the design studio. During this time, a variety of learning activities were unfolding simultaneously. Students in unit one were actively engaged in drawing on the board, their hands moving deftly. Meanwhile, students in other teams were seated in clusters, focused on their laptops and occupied with their individual tasks. For example, a group of students in a different part of the studio, quietly concentrating on their laptop screens, working on 3D modelling and analysing data related to their projects.

Apart from literal learning activities among students, "sweating" is also dramatic among 3rd-year students, but students showed different reactions to "sweating" even though they studied within the same design studio learning environment. For example, one student was dramatic "sweating" within his learning group, but other group members had negative feelings to his "sweating", as indicated in Field Notes 3.1.2-1, 16.00-17.00, 18th May, Wednesday 2022:

> One day before submitting the portfolio, Student F-Year 3 was doing his AT part, sitting on his seat within the 3rd-year design studio. During the process, he kept coughing with running nose. His fellows explained that he got a cold and fever. Even though, he still insisted on learning within the design studio. He claimed that he could ask for help, such as getting suggestions to his portfolio, from his fellows who were also studying there.

It is known from observations above that, 1st-year students tended to engage in the common informal learning activities between peers as the form of small-scale learning groups within the design studio learning environment of physical design studios. Compared with 1st-year students, 2nd-year ones typically engaged in relatively more diverse informal learning and non-study related activities between peers as the form of large-scale learning communities, which was constituted by several random small-scale learning groups, within physical design studios. 3rd-year students normally engaged in distinct informal learning activities between peers as the form of several specific small-scale learning groups, constituting a large-scale learning community within physical

design studios. Accordingly, communities of practice constituted by students in three academic years illustrated distinct traits. It was further found that peer-to-peer engagement between students within each community of practice also showed diverse characteristics. Specifically, under the theme of "Engaged Diversity", it was observed that group members in the same learning group made his/her forces to contribute to the construction their specific community of practice. For example, it was observed that some 1st-year students in the same learning group allocated specific tasks to complete the AT1 assignment, and this allocation helped their own learning, as shown in Field Notes 1.1.1-1, 15.00-19.45, 28th April, Thursday 2022

> As they worked, three of the students kept up a steady stream of conversation, discussing the questions posed by the assignment. They learned in towards each other, pointing at diagrams on their laptops' screens to illustrate their points. Occasionally, they paused to ponder over a particularly tricky problem and then pointed to others asking for help. At around 16.30, one of the three students made his way towards a student outside this learning group, seeking additional help. This lasted for a full half an hour, during which time the other two members of the group continued to work, occasionally looking up to see if their companion was on his way back. Meanwhile, the fourth student sat slightly apart and focused intently on his own task. He also engaged in occasional light conversation with the other three. Though they approached the assignment in different ways, they all worked towards the common goal of completing it.

Comparatively, 2nd-year students behaved more casual within their communities of practice. For example, it was observed that some specific 2nd-year students tended to engage in the same learning group, while they mainly focused on their own learning activities and occasionally communicated with each other, as shown in Field Notes 2.1.1-4, 13.00-15.00, 28th April, Thursday 2022:

> The majority of students have a propensity to sit in close proximity, surrounded by a large table. These "learning tables" were distinctly separated within the studio, indicating the presence of various learning groups. Typically, each learning group consisted of 2 to 6 students. For example, in one learning group of 5 students, 2 were chatting about a recent architectural exhibition they had visited, but the remaining 3 were concentrating on perfecting their design drafts.

Similarly, some specific 3rd-year students also tended to engage in the same learning group, and they also mainly focused on their own learning activities and occasionally communicated about their own projects with other group members. For example, as shown in Field Notes 3.1.4-2, 16.00-20.00 3rd May, Tuesday 2022

> Three students gathered around a table in the middle of the third-year design studio starting from 4 pm. Throughout the period, they were mainly occupied with their individual design projects while wearing headphones. This enabled them to remain undisturbed even amidst loud communications happening around them. One of them was multitasking by watching videos and carrying out the design work simultaneously. Occasionally, one student sought assistance from the one sitting opposite to her. Between 6.40 and 6.50 pm, two other students approached them to discuss extending the deadline for submitting the portfolio. At 7.30 pm, one student went to collect food delivery for all three of them. During dinner, they conversed and shared about their daily lives rather than their design projects. Another student joined their conversation until 8 pm. For example, one student asked for help from other two, regarding a software tool and a particular design element. The discussions about extending the portfolio deadline could have involved comparing the progress of each student and assessing the feasibility of the extension. While having dinner, they have shared stories about a funny incident that happened over the weekend or talked about a new movie they wanted to watch.

Likewise, as shown in Field Notes 3.1.1-4, 11.10-12.10 24th Mar, Thursday 2022

> Four students were seated together at one table in their year studio. Initially, they collectively allocated tasks for an architectural economy session, mapping out their responsibilities and approaches. Once this was done, they each delved into their own study individually, engrossed in their respective assigned tasks. In the midst of the process, two of them came together to discuss a specific issue that they had encountered. They engaged in a detailed conversation, sharing their perspectives and attempting to find solutions. Meanwhile, the other two continued with their own tasks, concentrating intently. Occasionally, they paused and joined the ongoing talk, contributing their thoughts and ideas, such as a significant progress and valuable insights on their allocated task.

It is found from observations above that, within the design studio learning environment of physical design studios, 1st-year students in the same learning group tended to engage in specific learning tasks which were allocated to them, and they had the clear aim for their learning groups. Comparatively, 2nd- and 3rd-year students in the same learning

groups tended to engage in their own learning activities in initiative, and they also casually interacted between group members.

6.3.2 Findings from Interviews and Focus Groups

Figure 30 illustrates the dataset of interviews and focus groups regarding the theme of "Mutual Engagement" in three academic years. Specifically, besides "Social Complexity" and "Engaged Diversity" manifesting distinct characteristics among three academic years, it was further found that other two sub-themes "Maintenance" and "Doing Things Together" also manifested distinct characteristics in 1st-, 2nd-, and 3rd-year students respectively. It is noticeable that the cubes within the hatch Green rectangle on the right side of the coding diagram depicts an inductive process, referring to the common characteristics of collected data regarding each academic year' informal learning between peers.

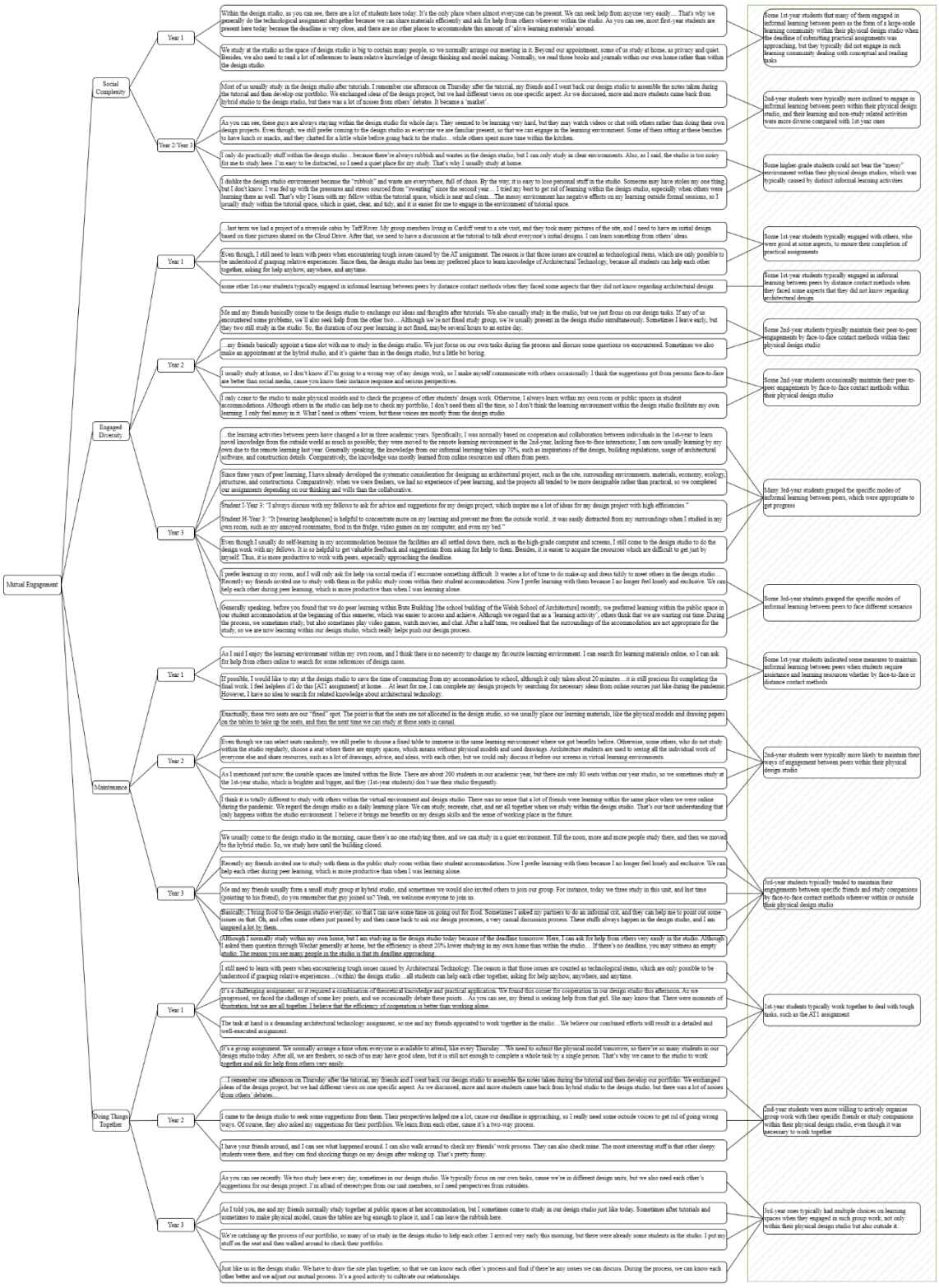

Figure 30 Data Collected from Interviews and Focus Groups Regarding Mutual Engagement in Three Academic Years

Compared with the themes coded from data of observations, the data collected from interviews and focus groups indicate more comprehensive perspectives on generating mutual engagement wherever within or outside physical design studios. For example,

under the theme of "Social Complexity", it was found from accounts of some 1st-year students that many of them engaged in informal learning between peers as the form of a large-scale learning community within their physical design studio when the deadline of submitting practical assignments was approaching, but they typically did not engage in such learning community dealing with conceptual and reading tasks. For instance, as indicated by Student E-Year 1 and Student I-Year 1, many 1st-year students typically gathered at their physical design studio for catching up the deadline of AT1 assignment and model making tasks:

> *Student E-Year 1: "Within the design studio, as you can see, there are a lot of students here today. It's the only place where almost everyone can be present. We can seek help from anyone very easily… That's why we generally do the technological assignment altogether because we can share materials efficiently and ask for help from others wherever within the studio. As you can see, most first-year students are present here today because the deadline is very close, and there are no other places to accommodate this amount of 'alive learning materials' around."*
>
> *Student I-Year 1: "We study at the studio as the space of design studio is big to contain many people, so we normally arrange our meeting in it. Beyond our appointment, some of us study at home, as privacy and quiet. Besides, we also need to read a lot of references to learn relative knowledge of design thinking and model making. Normally, we read those books and journals within our own home rather than within the design studio."*

Comparatively, 2nd-year students were typically more inclined to engage in informal learning between peers within their physical design studio even though there were no deadlines, and their learning and non-study related activities were more diverse compared with 1st-year ones. For example, as indicated by Student C-Year 2 and Student D-Year 2:

> *Student C-Year 2: "Most of us usually study in the design studio after tutorials. I remember one afternoon on Thursday after the tutorial, my friends and I went back our design studio to assemble the notes taken during the tutorial and then develop our portfolio. We exchanged ideas of the design project, but we had different views on one specific aspect. As we discussed, more and more students came back from hybrid studio to the design studio, but there was a lot of noises from others' debates. It became a 'market'."*
>
> *Student D-Year 2: "As you can see, these guys are always staying within the design studio for whole days. They seemed to be learning very hard, but they may watch videos or chat with others rather than doing their own design*

projects. Even though, we still prefer coming to the design studio as everyone we are familiar present, so that we can engage in the learning environment. Some of them sitting at these benches to have lunch or snacks, and they chatted for a little while before going back to the studio…while others spent more time within the kitchen."

Nevertheless, some higher-grade students indicated that they could not bear the "messy" environment within their physical design studios, within which there were full of voices from others' discussion, as well as drawings and physical models placing everywhere. The "messy" environment was typically caused by distinct informal learning activities. For example, as indicated by some higher-grade interviewees:

Student I-Year 2: "I only do practically stuff within the design studio…because there're always rubbish and wastes in the design studio, but I can only study in clear environments. Also, as I said, the studio is too noisy for me to study here. I'm easy to be distracted, so I need a quiet place for my study. That's why I usually study at home."

Student A-Year 3: "I dislike the design studio environment because the "rubbish" and waste are everywhere, full of chaos. By the way, it is easy to lose personal stuff in the studio. Someone may have stolen my one thing, but I don't know. I was fed up with the pressures and stress sourced from "sweating" since the second year… I tried my best to get rid of learning within the design studio, especially when others were learning there as well. That's why I learn with my fellow within the tutorial space, which is neat and clean…The messy environment has negative effects on my learning outside formal sessions, so I usually study within the tutorial space, which is quiet, clear, and tidy, and it is easier for me to engage in the environment of tutorial space."

It is known from accounts above that the complex of the design studio learning environment within physical design studios shows diverse scenes among three academic years. Specifically, 1st-year students' informal learning activities between peers within their physical design studio were typically mutual. Higher-grades students' informal learning activities between peers within their physical design studios were typically distinct, and different students showed different reactions to the complex of such design studio learning environment. Regarding such learning activities, the ways that students engaged in them were also distinct in different academic years. Specifically, under the theme of "Engaged Diversity", some 1st-year students typically engaged with others, who

were good at some aspects, by face-to-face contact methods to ensure their completion of practical assignments. For example, as indicated by Student H-Year 1 and Student D-Year 1:

> *Student H-Year 1: "…last term we had a project of a riverside cabin by Taff River. My group members living in Cardiff went to a site visit, and they took many pictures of the site, and I need to have an initial design based on their pictures shared on the Cloud Drive. After that, we need to have a discussion at the tutorial to talk about everyone's initial designs. I can learn something from others' ideas."*
>
> *Student D-Year 1: "Even though, I still need to learn with peers when encountering tough issues caused by the AT assignment. The reason is that those issues are counted as technological items, which are only possible to be understood if grasping relative experiences. Since then, the design studio has been my preferred place to learn knowledge of Architectural Technology, because all students can help each other together, asking for help anyhow, anywhere, and anytime."*

By contrast, some other 1st-year students typically engaged in informal learning between peers by distance contact methods when they faced some aspects that they did not know regarding architectural design. For example, as indicated by Student C-Year 1:

> *Student C-Year 1: "Most 1st-year students around me normally communicate with and asks for help from peers via social media rather than face-to-face peer learning. Even though, I can still grasp the valuable resources and knowledge I need. It is because their design projects and tasks are creative, and there are not enough practical requirements for them, so the students like me just need to search for critical knowledge and resources via social media or public resources in libraries or online, such as Pinterest, ArchDaily, Instagram, and Youtube channels."*

Comparatively, entering the second academic year, students in Year 2 gradually constituted peer-to-peer engagements with some friends and study companions. In addition, they began to face tougher design tasks, so they realised that they needed to ask for more help from others when they were outside formal timetable activities. Thus, many 2nd-year students were more inclined to engage in informal learning between peers by face-to-face within physical learning environments, especially their physical design studio. For example, Student A-Year 2 and Student B-Year 2 indicated their ways of the engagement of informal learning with their friends by face-to-face contact methods:

Student A-Year 2: "Me and my friends basically come to the design studio to exchange our ideas and thoughts after tutorials. We also casually study in the studio, but we just focus on our design tasks. If any of us encountered some problems, we'll also seek help from the other two… Although we're not fixed study group, we're usually present in the design studio simultaneously. Sometimes I leave early, but they two still study in the studio. So, the duration of our peer learning is not fixed, maybe several hours to an entire day."
Student B-Year 2: "…my friends basically appoint a time slot with me to study in the design studio. We just focus on our own tasks during the process and discuss some questions we encountered. Sometimes we also make an appointment at the hybrid studio, and it's quieter than in the design studio, but a little bit boring."

Different from them, some other students just occasionally engaged in informal learning between peers by face-to-face contact methods, as indicated by Student E-Year 2 and Student F-Year 2:

Student E-Year 2: "I usually study at home, so I don't know if I'm going to a wrong way of my design work, so I make myself communicate with others occasionally. I think the suggestions got from persons face-to-face are better than social media, cause you know their instance response and serious perspectives."
Student F-Year 2: "I only come to the studio to make physical models and to check the progress of other students' design work. Otherwise, I always learn within my own room or public spaces in student accommodations. Although others in the studio can help me to check my portfolio, I don't need them all the time, so I don't think the learning environment within the design studio facilitate my own learning. I only feel messy in it. What I need is others' voices, but these voices are mostly from the design studio."

It was found from interviews and focus groups to 3rd-year students that, after three years' learning, many students grasped the specific modes of informal learning between peers, which were appropriate for them to get progress. For example, some 3rd-year students were interviewed to talk about their acquisitions from studying architecture since Year 1, as stated by Student A-Year 3 and Student B-Year 3:

Student A-Year 3: "…the learning activities between peers have changed a lot in three academic years. Specifically, I was normally based on cooperation and collaboration between individuals in the 1st-year to learn novel knowledge from the outside world as much as possible; they were moved to the remote learning environment in the 2nd-year, lacking face-to-face interactions; I am now usually learning by my own due to the remote learning

last year. Generally speaking, the knowledge from our informal learning takes up 70%, such as inspirations of the design, building regulations, usage of architectural software, and construction details. Comparatively, the knowledge was mostly learned from online resources and others from peers."
Student B-Year 3: "Since three years of peer learning, I have already developed the systematic consideration for designing an architectural project, such as the site, surrounding environments, materials, economy, ecology, structures, and constructions. Comparatively, when we were freshers, we had no experience of peer learning, and the projects all tended to be more designable rather than practical, so we completed our assignments depending on our thinking and wills than the collaborative."

In addition, two students (Student H-Year 3 and Student I-Year 3), who usually studied at two adjacent tables within the 3rd-year studio, indicated that they could be more concentrated when learning within their physical design studio. Specifically, they both grasped their own ways to learn efficiently and the sense of cooperation while learning within their physical design studio. They articulated at Focus Group 3.1.2-1, 11th May, Wednesday 2022:

Student I-Year 3: "I always discuss with my fellows to ask for advice and suggestions for my design project, which inspire me a lot of ideas for my design project with high efficiencies."
Student H-Year 3: "It [wearing headphones] is helpful to concentrate more on my learning and prevent me from the outside world...it was easily distracted from my surroundings when I studied in my own room, such as my annoyed roommates, food in the fridge, video games on my computer, and even my bed."

Besides different types of students' informal learning between peers, the learning modes of some 3rd-year students were also vary when they encountered diverse scenarios, just as the statements by some interviewees below:

Student G-Year 3: "Even though I usually do self-learning in my accommodation because the facilities are all settled down there, such as the high-grade computer and screens, I still come to the design studio to do the design work with my fellows. It is so helpful to get valuable feedback and suggestions from asking for help to them. Besides, it is easier to acquire the resources which are difficult to get just by myself. Thus, it is more productive to work with peers, especially approaching the deadline."
Student E-Year 3: "I prefer learning in my room, and I will only ask for help via social media if I encounter something difficult. It wastes a lot of time to

do make-up and dress tidily to meet others in the design studio…Recently my friends invited me to study with them in the public study room within their student accommodation. Now I prefer learning with them because I no longer feel lonely and exclusive. We can help each other during peer learning, which is more productive than when I was learning alone."

Student D-Year 3: "Generally speaking, before you found that we do peer learning within Bute Building [the school building of the Welsh School of Architecture] recently, we preferred learning within the public space in our student accommodation at the beginning of this semester, which was easier to access and achieve. Although we regard that as a 'learning activity', others think that we are wasting our time. During the process, we sometimes study, but also sometimes play video games, watch movies, and chat. After a half term, we realised that the surroundings of the accommodation are not appropriate for the study, so we are now learning within our design studio, which really helps push our design process."

It is known from students' accounts above that the ways of peer-to-peer engagements between students are diverse among three academic years. Specifically, 1st-year students were still exploring their own ways of engaging in informal learning between peers. Comparatively, higher-grade students found their specific ways of their engagements between peers, and they also found their ways to maintain these engagements in different situations. For example, under the theme of "Maintenance", some 1st-year students indicated some measures to maintain informal learning between peers when students require assistance and learning resources whether by face-to-face or distance contact methods:

Student B-Year 1: "As I said I enjoy the learning environment within my own room, and I think there is no necessity to change my favourite learning environment. I can search for learning materials online, so I can ask for help from others online to search for some references of design cases."

Student D-Year 1: "If possible, I would like to stay at the design studio to save the time of commuting from my accommodation to school, although it only takes about 20 minutes…it is still precious for completing the final work. I feel helpless if I do this [AT1 assignment] at home… At least for me, I can complete my design projects by searching for necessary ideas from online sources just like during the pandemic. However, I have no idea to search for related knowledge about architectural technology."

Compared with 1st-year students, 2nd-year ones were typically more likely to maintain their ways of engagement between peers within their physical design studio, since most

of them were typically more inclined to study within their physical design studio outside formal timetable activities. For example, some 2nd-year interviewees indicated their ways for maintenance their peer-to-peer engagements between friends and study companions within their physical design studio, even though they encountered some difficulties:

> *Student C-Year 2: "Exactually, these two seats are our "fixed" spot. The point is that the seats are not allocated in the design studio, so we usually place our learning materials, like the physical models and drawing papers on the tables to take up the seats, and then the next time we can study at these seats in casual."*
> *Student D-Year 2: "Even though we can select seats randomly, we still prefer to choose a fixed table to immerse in the same learning environment where we got benefits before. Otherwise, some others, who do not study within the studio regularly, choose a seat where there are empty spaces, which means without physical models and used drawings. Architecture students are used to seeing all the individual work of everyone else and share resources, such as a lot of drawings, advice, and ideas, with each other, but we could only discuss it before our screens in virtual learning environments."*
> *Student G-Year 2: "As I mentioned just now, the useable spaces are limited within the Bute. There are about 200 students in our academic year, but there are only 80 seats within our year studio, so we sometimes study at the 1st-year studio, which is brighter and bigger, and they (1st-year students) don't use their studio frequently."*

Student H-Year 2 explained the reasons why many 2nd-year students maintained their peer-to-peer engagement within the physical design studio:

> *Student H-Year 2: "I think it is totally different to study with others within the virtual environment and design studio. There was no sense that a lot of friends were learning within the same place when we were online during the pandemic. We regard the design studio as a daily learning place. We can study, recreate, chat, and eat all together when we study within the design studio. That's our tacit understanding that only happens within the studio environment. I believe it brings me benefits on my design skills and the sense of working place in the future."*

A little different from such 2nd-year students, many 3rd-year ones typically tended to maintain their engagements between specific friends and study companions by face-to-face contact methods wherever within or outside their physical design studio, as indicated by some interviewees:

Student D-Year 3: "We usually come to the design studio in the morning, cause there's no one studying there, and we can study in a quiet environment. Till the noon, more and more people study there, and then we moved to the hybrid studio. So, we study here until the building closed."
Student E-Year 3: "Recently my friends invited me to study with them in the public study room within their student accommodation. Now I prefer learning with them because I no longer feel lonely and exclusive. We can help each other during peer learning, which is more productive than when I was learning alone."
Student F-Year 3: "Me and my friends usually form a small study group at hybrid studio, and sometimes we would also invited others to join our group. For instance, today we three study in this unit, and last time (pointing to his friend), do you remember that guy joined us? Yeah, we welcome everyone to join us."
Student H-Year 3: "Basically, I bring food to the design studio everyday, so that I can save some time on going out for food. Sometimes I asked my partners to do an informal crit, and they can help me to point out some issues on that. Oh, and often some others just passed by and then came back to ask our design processes, a very casual discussion process. These stuffs always happen in the design studio, and I am inspired a lot by them."

In addition, some 3rd-year students were also inclined to engage in informal learning between their peers by distance contact methods when the deadline was not approaching. For example:

Student G-Year 3: "Although I normally study within my own home, but I am studying in the design studio today because of the deadline tomorrow. Here, I can ask for help from others very easily in the studio. Although I asked them question through Wechat generally at home, but the efficiency is about 20% lower studying in my own home than within the studio… If there's no deadline, you may witness an empty studio. The reason you see many people in the studio is that its deadline approaching."

It is known from students' accounts above that the ways of maintaining peer-to-peer engagements between students are diverse among three academic years. Nevertheless, most of them still needed to work together with peers to make their own learning better when they were outside formal timetable activities. Specifically, under the theme of "Doing Things Together", some 1st-year students indicated some examples of mode of group work, as indicated by Student I-Year 1:

> *Student I-Year 1: "Normally, we just arrange a specific time when everyone in the assigned group is available to arrange the task and cooperate to complete the work. For example, our group normally arrange every Thursday as the group-work day, so we were all making models in the studio that day, as you saw yesterday. Beyond that time, we hardly went to the studio also, as you saw this Tuesday."*

Likewise, some students indicated a similar learning mode when they deal with the tough tasks. For example, inquiring about AT1 assignment is a common occurrence among the majority of 1st-year students, so some interviewees indicated that they completed the AT1 assignment by group work:

> *Student D-Year 1: "I still need to learn with peers when encountering tough issues caused by Architectural Technology. The reason is that those issues are counted as technological items, which are only possible to be understood if grasping relative experiences…(within) the design studio…all students can help each other together, asking for help anyhow, anywhere, and anytime."*
> *Student E-Year 1: "It's a challenging assignment, so it required a combination of theoretical knowledge and practical application. We found this corner for cooperation in our design studio this afternoon. As we progressed, we faced the challenge of some key points, and we occasionally debate these points…As you can see, my friend is seeking help from that girl. She may know that. There were moments of frustration, but we are all together. I believe that the efficiency of cooperation is better than working alone."*
> *Student F-Year 1: "The task at hand is a demanding architectural technology assignment, so me and my friends appointed to work together in the studio…We believe our combined efforts will result in a detailed and well-executed assignment."*
> *Student I-Year 1: "It's a group assignment. We normally arrange a time when everyone is available to attend, like every Thursday…We need to submit the physical model tomorrow, so there're so many students in our design studio today. After all, we are freshers, so each of us may have good ideas, but it is still not enough to complete a whole task by a single person. That's why we came to the studio to work together and ask for help from others very easily."*

Thus, the usage of the 1st-year physical design studio by 1st-year students depends on the type of task that students needed to complete. For example, if there were only architectural design tasks, most students only spent a little time on group work and sought help from others. In contrast, if a group work or an architectural technological task required group members to discuss and cooperate, students typically organised a regular

group meeting every week or biweekly when everyone was available. Different from 1st-year students, 2nd-year ones were more willing to actively organise group work with their specific friends or study companions within their physical design studio, even though it was necessary to work together. For example:

> *Student C-Year 2: "…I remember one afternoon on Thursday after the tutorial, my friends and I went back our design studio to assemble the notes taken during the tutorial and then develop our portfolio. We exchanged ideas of the design project, but we had different views on one specific aspect. As we discussed, more and more students came back from hybrid studio to the design studio, but there was a lot of noises from others' debates…"*
> *Student F-Year 2: "I came to the design studio to seek some suggestions from them. Their perspectives helped me a lot, cause our deadline is approaching, so I really need some outside voices to get rid of going wrong ways. Of course, they also asked my suggestions for their portfolios. We learn from each other, cause it's a two-way process."*
> *Student H-Year 2: "I have your friends around, and I can see what happened around. I can also walk around to check my friends' work process. They can also check mine. The most interesting stuff is that other sleepy students were there, and they can find shocking things on my design after waking up. That's pretty funny."*

Similar to 2nd-year students, many 3rd-year ones also typically needed to do work together with their friends and study companions, to avoid their own learning going wrong ways. Even though, different from 2nd-year students, 3rd-year ones typically had multiple choices on learning spaces when they engaged in such group work, not only within their physical design studio but also outside it. For example, some 3rd-year interviewees indicated their ways of working with peers together:

> *Student D-Year 3: "As you can see recently. We two study here [the tutorial space] every day, sometimes in our design studio. We typically focus on our own tasks, cause we're in different design units, but we also need each other's suggestions for our design project. I'm afraid of stereotypes from our unit members, so I need perspectives from outsiders."*
> *Student J-Year 3: "As I told you, me and my friends normally study together at public spaces at her accommodation, but I sometimes come to study in our design studio just like today. Sometimes after tutorials and sometimes to make physical model, cause the tables are big enough to place it, and I can leave the rubbish here."*

Student L-Year 3: "We're catching up the process of our portfolio, so many of us study in the design studio to help each other. I arrived very early this morning, but there were already some students in the studio. I put my stuff on the seat and then walked around to check their portfolio."
Student M-Year 3: "Just like us in the design studio. We have to draw the site plan together, so that we can know each other's process and find if there're any issues we can discuss. During the process, we can know each other better and we adjust our mutual process. It's a good activity to cultivate our relationships."

It is known from above that students have their specific ways of peer-to-peer engagements in different academic years.

6.3.3 The Ways that Mutual Engagement Develop throughout Three Academic Years

The data illustrated in the last two sections depicted that, among three academic years, 1st-year architecture students experienced limited informal learning activities between peers especially within the design studio learning environment of physical design studios. This phenomenon seems conflict with the statement of the Year Chair of Year 1:

1st-Year Chair: "1st-year students should be the most engaged and creative in the design studio learning environment throughout three academic years… (they) should learn within an environment full of shocking, creative, crazy ideas, to cultivate a sense of architectural design…1st-year students were almost living in the studio (before the pandemic), totally engaged in the peer learning atmosphere, making crazy models and shocking designs whatever they want, and the only thing they could not make is love."

It is known from the statement of 1st-Year Chair that peer-to-peer engagements of architecture students should be experienced face-to-face rather than isolated at home. However, the policy of "work from home" during the COVID-19 pandemic brought some negative aspects to students' learning outside formal timetable activities, as indicated by 1st-Year Chair:

1st-Year Chair: "Students were still required to keep social distance and avoid touching others' design crafts…despite that they were allowed to learn within the studio at the beginning of the second term of the academic year 2021-2022…they are now reluctant to learn from others with high grades because they have already got used to learning online and individually."

The statements of 1st-Year Chair above explained the reason why many 1st-year study participants were typically maintaining peer-to-peer engagements by distance contact methods rather than actively engaging in informal learning between peers face-to-face within the design studio learning environment especially within their physical design studio. By contrast, they still created face-to-face peer-to-peer engagements within their physical design studio when they needed to deal with practical tasks, such as AT1 and modelling assignment.

Comparatively, entering the second academic year, architecture students commenced dealing with actual building projects, and thus they were required to learn more comprehensive knowledge and skills of architectural design and technology. As indicated by 2nd-Year Chair, 2nd-year students were required to engage in more cooperations between peers:

> *2nd-Year Chair: "There are two big and individual design projects for 2nd-year students, one a housing project and another a public project…There are also two small and cooperative sessions lasting several weeks to train students' senses and ability of cooperations."*

Although the architectural projects did not mandate students' cooperations, a proportion of students still tended to organise communities of practice with their friends and study companions to deal with these projects, because they had already reaped the benefits of informal learning between peers, as indicated by 2nd-Year Chair:

> *2nd-Year Chair: "The tendency of the progress of students, who usually learn in a group, are obvious compared with the ones who normally learn in individual, even if they are very talented designers…The ones who learn in groups are progressed by reviewing others' projects and ideas, and do self-review, self-test, and self-finding to digest, while the ones learn in individuals are only on their own without novel ideas."*

This phenomenon enabled many 2nd-year students to regard learning in physical design studio as part of their daily routine. Even though they were dedicated in the deadline to submit the final work, they still remained relaxed and enjoyed themselves when engaged in the design studio learning environment of physical design studios. Meanwhile, since the learning tasks and the sense of cooperative learning were developed in the 2nd year,

students generally have the sense of "sweating" between peers. Thus, even though some students were aware of the benefits of informal learning between peers and the environment within the physical design studio, they still preferred learning outside the design studio learning environment to prevent them from the dramatic "sweating". It was noticeable that the "sweating" was pronounced within the design studio learning environment within physical design studios, so some students tended to constitute the design studio learning environment outside physical design studios. After all, 2nd-year students were typically willing to engage in informal learning in their learning groups or learning communities.

Similar to 2nd-year students, 3rd-year ones were typically inclined to actively engage in informal learning between peers. Specifically, after three years' architectural learning, many 3rd-year students have grasped the sense that architecture is a practice-based discipline. Thus, many of them believed that learning from multiple individuals could provide each other with more inspiration, discover more possibilities for solving a problem, enable more conflict thinking, and make architecture more diverse. Meanwhile, many of them tended to maintain their peer-to-peer engagements in more diverse ways wherever within and outside physical design studios. For example, some of them tended to engage with specific friends and study companions as the form of small-scale learning groups within their physical design studios in the morning, and they maintained their learning group within the tutorial space at noon. Some of them tended to constitute their learning groups within their accommodation at the beginning of a design project, and they maintained their learning group within the tutorial space or physical design studio when the deadline was approaching.

6.4 A Joint Enterprise

This section presents the findings of informal learning activities and the perceptions regarding them from 1st-, 2nd-, and 3rd-year students respectively, under the theme of "A Joint Enterprise".

6.4.1 Findings from Observations

Figure 31 illustrates the dataset of observations regarding the theme of "A Joint Enterprise" in three academic years. Specifically, it was found that only two sub-themes "Rhythms" and "Mutual Accountability" manifested distinct characteristics in 1st-, 2nd-, and 3rd-year students respectively. It is noticeable that the cubes within the hatch Green rectangle on the right side of the coding diagram depicts an inductive process, referring to the common characteristics of collected data regarding each academic year' informal learning between peers.

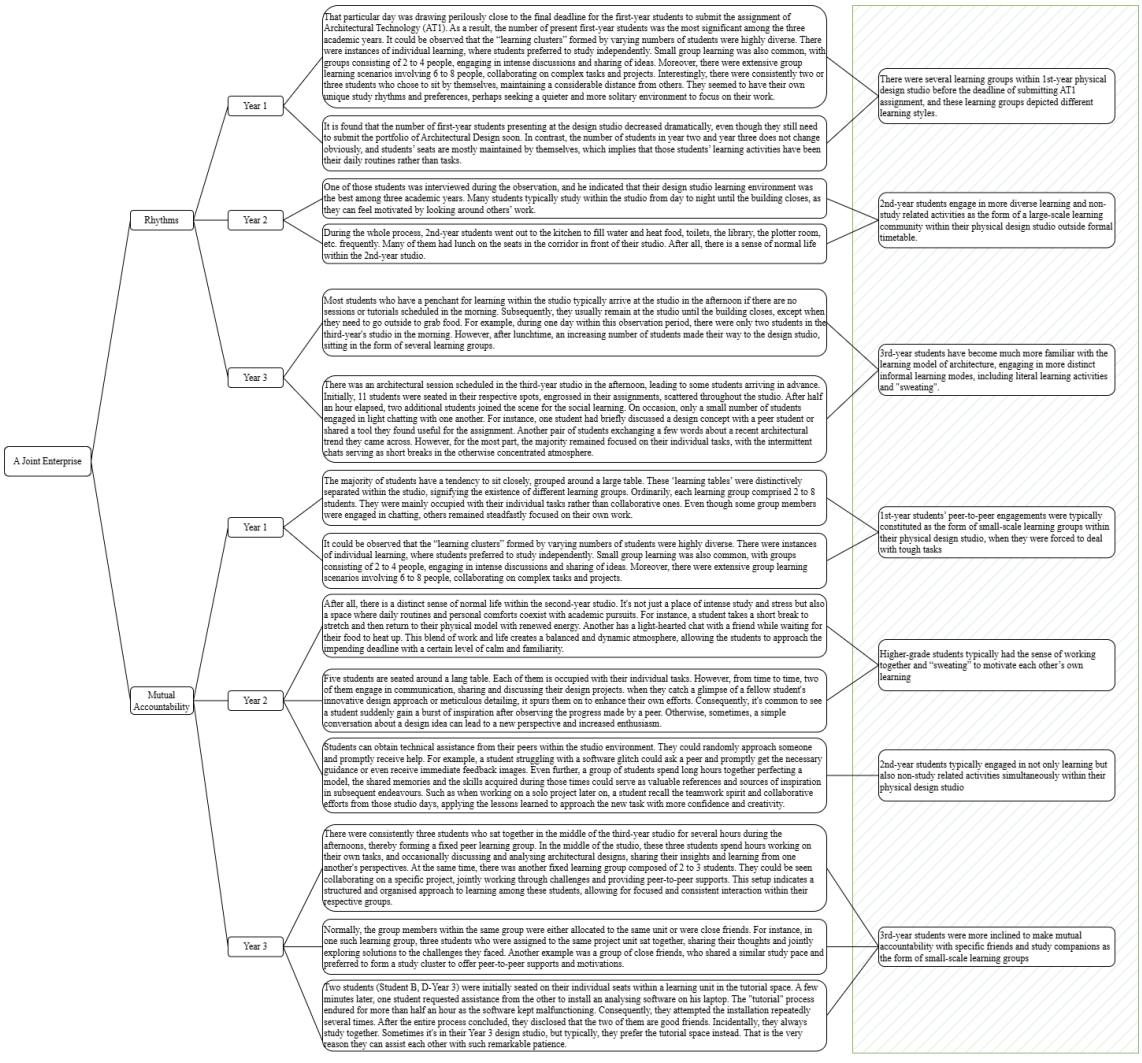

Figure 31 Data Collected from Observations Regarding A Joint Enterprise in Three Academic Years

Under the theme of “Rhythms”, it was observed that nearly half of the 1st-year students study within the studio before the deadline for submitting the AT assignment, as shown in Field Notes 1.1.3-1, 15.00-15.30 on 3rd November, Thursday 2022:

> That particular day was drawing perilously close to the final deadline for the first-year students to submit the assignment of Architectural Technology (AT1). As a result, the number of present first-year students was the most significant among the three academic years. It could be observed that the “learning clusters” formed by varying numbers of students were highly diverse. There were instances of individual learning, where students preferred to study independently. Small group learning was also common, with groups consisting of 2 to 4 people, engaging in intense discussions and sharing of ideas. Moreover, there were extensive group learning scenarios involving 6 to 8 people, collaborating on complex tasks and projects. Interestingly, there were consistently two or three students who chose to sit by themselves, maintaining a considerable distance from others. They seemed to have their own unique study rhythms and preferences, perhaps seeking a quieter and more solitary environment to focus on their work.

In contrast to students' eagerness to complete the assignment before the submission deadline, it was found that after submitting the AT1 assignment, there were merely three students in the studio. Specifically, as shown in Field Notes 1.1.3-2, from 15.00-15.30 on 8th November, Tuesday 2022:

> It is found that the number of first-year students presenting at the design studio decreased dramatically, even though they still need to submit the portfolio of Architectural Design soon. In contrast, the number of students in year two and year three does not change obviously, and students’ seats are mostly maintained by themselves, which implies that those students’ learning activities have been their daily routines rather than tasks.

It is found from observations above that the ways of 1st-year students’ peer-to-peer engagements within their physical design studio are typically distinct depending on if the deadlines approaching. In addition, except approaching deadlines, there are still very limited 1st-year students in their physical design studio, even though the context and facilities are the best in three academic years. Specifically, 1st-year physical design studio possesses the biggest area and the most comprehensive spaces among three design studios for undergraduate students. Besides, the sanitary condition of the 1st-year physical design studio is also the best among the three academic years, with no physical models and

drawings on the table or floor, which implies that the design tasks and abilities of 1st-year students mostly do not rely on the design studio learning environment. As depicted in Figure 32, the empty and tidy studio seems out of place for the discipline of architecture.

Figure 32 The Condition of First-Year Design Studio after the Deadline (taken by Jierui Wang)

Comparatively, it seems to be a habitus for many 2nd-year students to constitute their peer-to-peer engagements within their physical design studio, as shown in Field Notes 2.1.2, 13.30-14.00, 4th May, Wednesday 2022:

> One of those students was interviewed during the observation, and he indicated that their design studio learning environment was the best among three academic years. Many students typically study within the studio from day to night until the building closes, as they can feel motivated by looking around others' work.

Besides the design studio learning environment within the 2nd-year physical design studio, there are many learning- and living-supportive facilities around this physical design studio, to ensure that students can stay within it for a prolonged time. As shown in Figure 33, it is the surrounding facilities around the 2nd-year design studio. For example, as shown in Field Notes 2.1.3-2, 13.00-15.30, 10th May, Tuesday 2022 are presented below.

> During the whole process, 2nd-year students went out to the kitchen to fill water and heat food, toilets, the library, the plotter room, etc. frequently. Many of them had lunch on the seats in the corridor in front of their studio. After all, there is a sense of normal life within the 2nd-year studio.

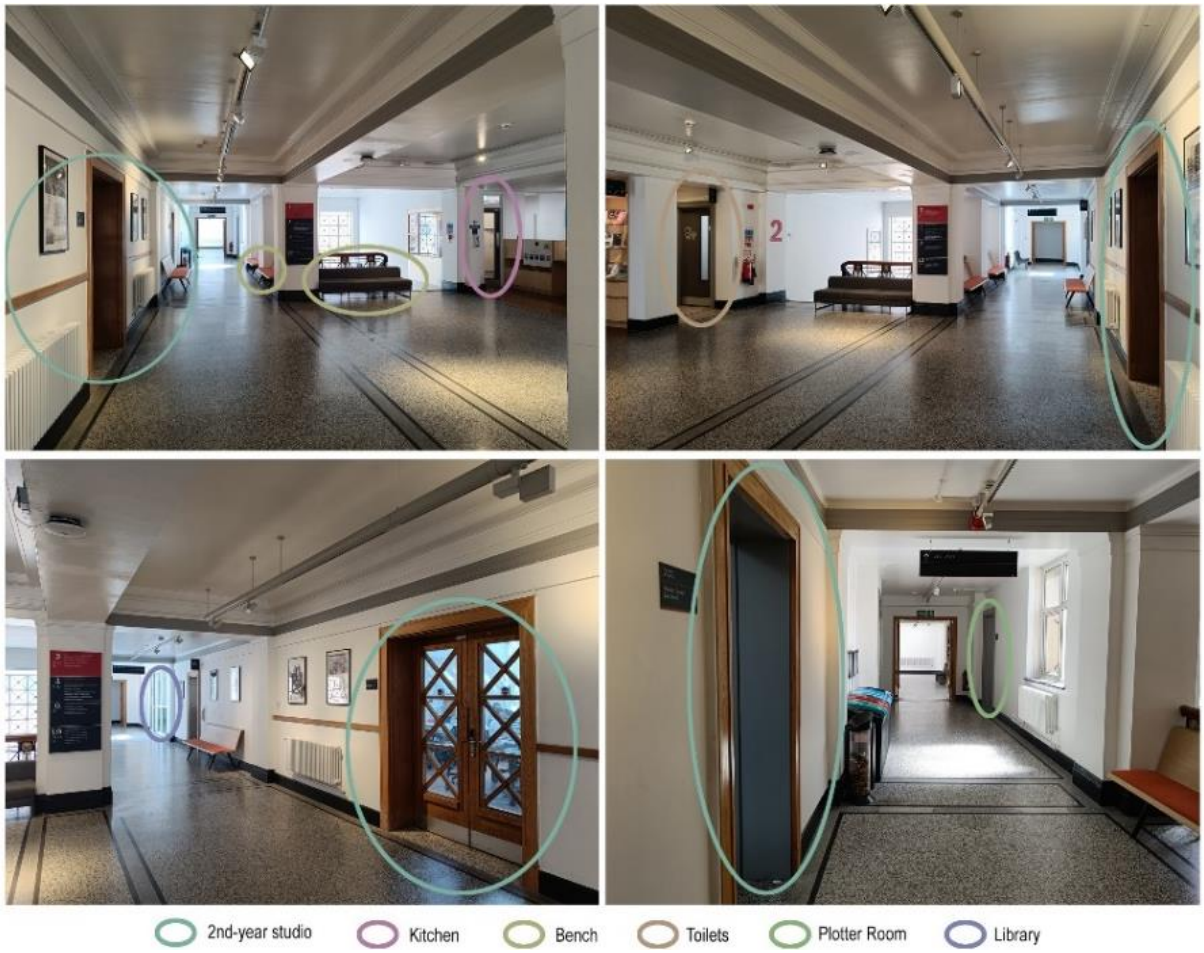

Figure 33 The 2nd-Year Studio and Facilities around It (taken by Jierui Wang)

It is found from observations above that 2nd-year students typically have the rhythm of engaging in informal learning between peers within the design studio learning environment of their physical design studio for a prolonged period. Similarly, 3rd-year students also typically had their rhythm of engaging in informal learning between peers within their physical design studio. For example, as shown in Field Notes 3.1.1-2, 11.00-14.00, 25th-30th April, Monday-Saturday 2022:

> Most students who have a penchant for learning within the studio typically arrive at the studio in the afternoon if there are no sessions or tutorials scheduled in the morning. Subsequently, they usually remain at the studio until the building closes, except when they need to go outside to grab food. For example, during one day within this observation period, there were only two students in the third-year's studio in the morning. However, after lunchtime, an increasing number of students made their way to the design studio, sitting in the form of several learning groups.

Likewise, as shown in Field Notes 3.1.4-1, 11.10-12.10 24th Mar, Thursday 2022

> There was an architectural session scheduled in the third-year studio in the afternoon, leading to some students arriving in advance. Initially, 11 students were seated in their respective spots, engrossed in their assignments, scattered throughout the studio. After half an hour elapsed, two additional students joined the scene for the social learning. On occasion, only a small number of students engaged in light chatting with one another. For instance, one student had briefly discussed a design concept with a peer student or shared a tool they found useful for the assignment. Another pair of students exchanging a few words about a recent architectural trend they came across. However, for the most part, the majority remained focused on their individual tasks, with the intermittent chats serving as short breaks in the otherwise concentrated atmosphere.

It is known from observations above that the rhythms of engaging in informal learning between peers within physical design studios are distinct among three academic years. Specifically, the peer-to-peer engagements between 1st-year students are decided by the deadline of submitting practical assignment. The engagements between 2nd-year students are typically kept for prolonged periods. The engagements between 3rd-year students are typically constituted around lunch time till the school building closed, otherwise they are constituted before or after formal timetable activities. Among these various peer-to-peer engagements, students had different levels of mutual accountability. Specifically, under the theme of "Mutual Accountability", it was observed that 1st-year students' peer-to-peer engagements were typically constituted as the form of small-scale learning groups within their physical design studio, when they were forced to deal with tough tasks, as shown in Field Notes 1.1.1-2, 16.00-19.45, 28th April, Thursday 2022:

> The majority of students have a tendency to sit closely, grouped around a large table. These "learning tables" were distinctively separated within the studio, signifying the existence of different learning groups. Ordinarily, each learning group comprised 2 to 8 students. They were mainly occupied with their individual tasks rather than collaborative ones. Even though some group members were engaged in chatting, others remained steadfastly focused on their own work.

Likewise, Field Notes 1.1.3-1, 15.00-15.30 on 3rd November, Thursday 2022:

> It could be observed that the "learning clusters" formed by varying numbers of students were highly diverse. There were instances of individual learning, where students preferred to study independently. Small group learning was

> also common, with groups consisting of 2 to 4 people, engaging in intense discussions and sharing of ideas. Moreover, there were extensive group learning scenarios involving 6 to 8 people, collaborating on complex tasks and projects.

It was further observed that higher-grade students typically had the sense of working together and "sweating" to motivate each other's own learning. For example, as shown in Field Notes 2.1.2, 13.30-14.00, 4th May, Wednesday 2022:

> Five students are seated around a lang table. Each of them is occupied with their individual tasks. However, from time to time, two of them engage in communication, sharing and discussing their design projects. when they catch a glimpse of a fellow student's innovative design approach or meticulous detailing, it spurs them on to enhance their own efforts. Consequently, it's common to see a student suddenly gain a burst of inspiration after observing the progress made by a peer. Otherwise, sometimes, a simple conversation about a design idea can lead to a new perspective and increased enthusiasm.

Likewise, as shown in Field Notes 2.1.4, 13.00-15.00, 10th May, Tuesday 2022:

> Students can obtain technical assistance from their peers within the studio environment. They could randomly approach someone and promptly receive help. For example, a student struggling with a software glitch could ask a peer and promptly get the necessary guidance or even receive immediate feedback images. Even further, a group of students spend long hours together perfecting a model, the shared memories and the skills acquired during those times could serve as valuable references and sources of inspiration in subsequent endeavours. Such as when working on a solo project later on, a student recall the teamwork spirit and collaborative efforts from those studio days, applying the lessons learned to approach the new task with more confidence and creativity.

In addition, it was also observed that 2nd-year students typically engaged in not only learning but also non-study related activities simultaneously within their physical design studio, as shown in Field Notes 2.1.3-2, 13.00-15.30, 10th May, Tuesday 2022

> After all, there is a distinct sense of normal life within the second-year studio. It's not just a place of intense study and stress but also a space where daily routines and personal comforts coexist with academic pursuits. For instance, a student takes a short break to stretch and then return to their physical model with renewed energy. Another has a light-hearted chat with a friend while waiting for their food to heat up. This blend of work and life creates a balanced and dynamic atmosphere, allowing the students to approach the impending deadline with a certain level of calm and familiarity.

It is known from observations above that many 2nd-year students typically engaged in informal learning between peers within their physical design studio, and they asked for help and help others to ensure that they could get progress together. Comparatively, 3rd-year students were more inclined to make mutual accountability with specific friends and study companions as the form of small-scale learning groups. For example, as shown in Field Notes 3.1.2-2, 14.30-16.00, 15th-18th May, Sunday-Wednesday 2022

> There were consistently three students who sat together in the middle of the third-year studio for several hours during the afternoons, thereby forming a fixed peer learning group. In the middle of the studio, these three students spend hours working on their own tasks, and occasionally discussing and analysing architectural designs, sharing their insights and learning from one another's perspectives. At the same time, there was another fixed learning group composed of 2 to 3 students. They could be seen collaborating on a specific project, jointly working through challenges and providing peer-to-peer supports. This setup indicates a structured and organised approach to learning among these students, allowing for focused and consistent interaction within their respective groups.

It was also observed that, after three years' learning, many 3rd-year students typically constituted peer-to-peer engagements with more specific modes, as shown in Field Notes 3.1.1-2, 11.00-14.00, 25th-30th April, Monday-Saturday 2022

> Normally, the group members within the same group were either allocated to the same unit or were close friends. For instance, in one such learning group, three students who were assigned to the same project unit sat together, sharing their thoughts and jointly exploring solutions to the challenges they faced. Another example was a group of close friends, who shared a similar study pace and preferred to form a study cluster to offer peer-to-peer supports and motivations.

In addition, some 3rd-year students were observed that they could switch learning spaces within and outside their physical design studio, to cope with different scenarios, as shown in Field Notes 3.2.1, 15.00-16.00 11th May, Wednesday 2022

> Two students (Student B, D-Year 3) were initially seated on their individual seats within a learning unit in the tutorial space. A few minutes later, one student requested assistance from the other to install an analysing software on his laptop. The "tutorial" process endured for more than half an hour as the software kept malfunctioning. Consequently, they attempted the installation repeatedly several times. After the entire process concluded, they disclosed

that the two of them are good friends. Incidentally, they always study together. Sometimes it's in their Year 3 design studio, but typically, they prefer the tutorial space instead. That is the very reason they can assist each other with such remarkable patience.

It is known from observations above that, students achieved the mutual accountability, which was created by peer-to-peer engagements, experiencing a comprehensive process.

6.4.2 Findings from Interviews and Focus Groups

Figure 34 illustrates the dataset of interviews and focus groups regarding the theme of "A Joint Enterprise" in three academic years. Specifically, besides "Rhythms" and "Mutual Accountability" manifesting distinct characteristics among three academic years, it was further found that another sub-theme "Interpretation" also manifested distinct characteristics in 1st-, 2nd-, and 3rd-year students respectively. It is noticeable that the cubes within the hatch Green rectangle on the right side of the coding diagram depicts an inductive process, referring to the common characteristics of collected data regarding each academic year' informal learning between peers.

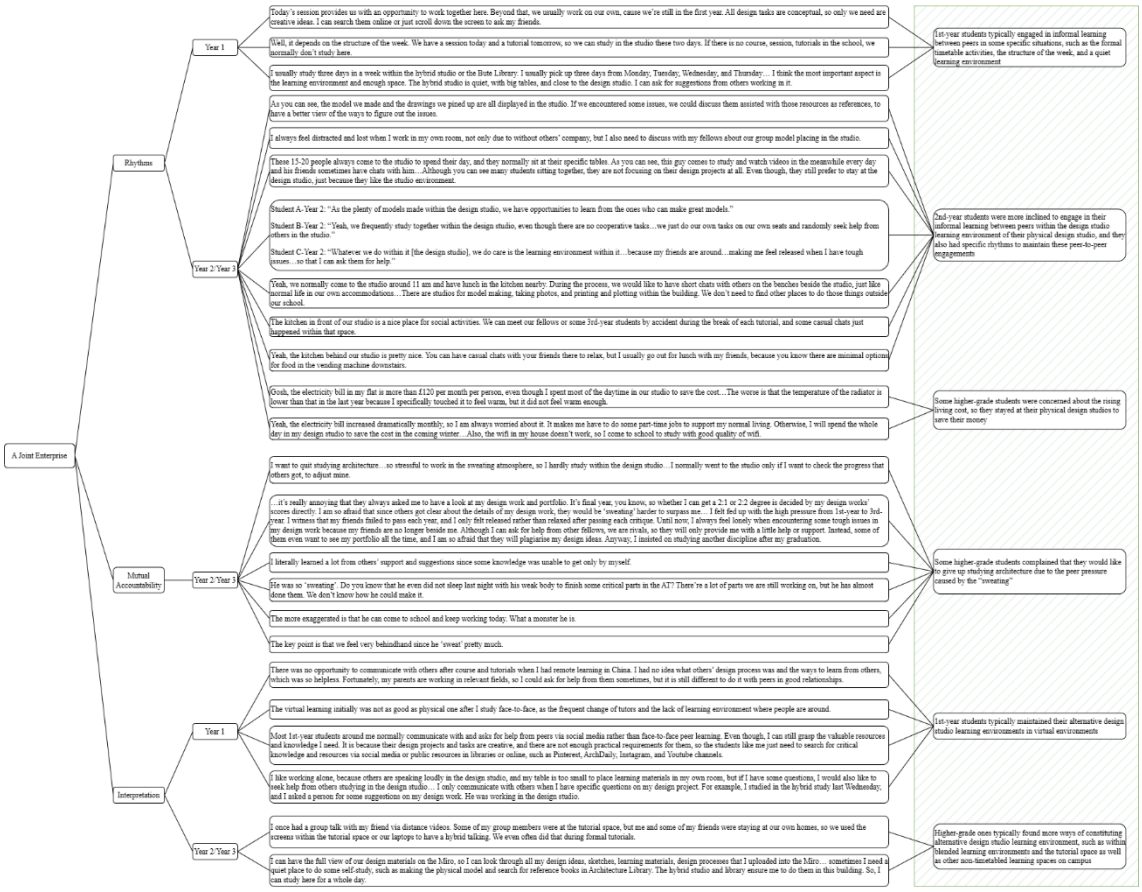

Figure 34 Data Collected from Interviews and Focus Groups Regarding A Joint Enterprise in Three Academic Years

Compared with the themes coded from data of observations, the data collected from interviews and focus groups indicate more comprehensive perspectives on ensuring a joint enterprise wherever within or outside physical design studios. Specifically, under the theme of "Rhythms", it was found from students' accounts that they typically had their own rhythms on constituting peer-to-peer engagements when engaging in informal learning between peers. For example, it was found that 1st-year students typically engaged in informal learning between peers in some specific situations, such as the formal timetable activities and the structure of the week, as indicated below:

> *Student F-Year 1: "Today's session provides us with an opportunity to work together here. Beyond that, we usually work on our own, cause we're still in the first year. All design tasks are conceptual, so only we need are creative ideas. I can search them online or just scroll down the screen to ask my friends."*

Student G-Year 1: "Well, it depends on the structure of the week. We have a session today and a tutorial tomorrow, so we can study in the studio these two days. If there is no course, session, tutorials in the school, we normally don't study here."

In addition, some 1st-year students made themselves to regularly study within a quiet learning environment on campus, as indicated by Student J-Year 1 below. However, the number of these students were limited compared with higher-grade ones.

Student J-Year 1: "I usually study three days in a week within the hybrid studio or the Bute Library. I usually pick up three days from Monday, Tuesday, Wednesday, and Thursday… I think the most important aspect is the learning environment and enough space. The hybrid studio is quiet, with big tables, and close to the design studio. I can ask for suggestions from others working in it."

Compared with most of 1st-year students, it was usually found among 2nd-year students that many of them were more inclined to engage in their informal learning between peers within the design studio learning environment of their physical design studio, and they also had specific rhythms to maintain these peer-to-peer engagements. For example, some interviewees indicated their routines of studying within the 2nd-year design studio:

Student A-Year 2: "As you can see, the model we made and the drawings we pined up are all displayed in the studio. If we encountered some issues, we could discuss them assisted with those resources as references, to have a better view of the ways to figure out the issues."

Student B-Year 2: "I always feel distracted and lost when I work in my own room, not only due to without others' company, but I also need to discuss with my fellows about our group model placing in the studio.".

Student D-Year 2: "These 15-20 people always come to the studio to spend their day, and they normally sit at their specific tables. As you can see, this guy comes to study and watch videos in the meanwhile every day and his friends sometimes have chats with him…Although you can see many students sitting together, they are not focusing on their design projects at all. Even though, they still prefer to stay at the design studio, just because they like the studio environment."

In addition, Student A-Year 2, Student B-Year 2, and Student C-Year 2 were taken a focus group to identify their accounts from interviews, and they still claimed that they kept the rhythm of learning within the design studio learning environment with their physical

design studio, which was helpful for their own learning. As shown in Focus Group 2.1.3, 13th May, Friday 2022:

> *Student A-Year 2: "As the plenty of models made within the design studio, we have opportunities to learn from the ones who can make great models."*
> *Student B-Year 2: "Yeah, we frequently study together within the design studio, even though there are no cooperative tasks…we just do our own tasks on our own seats and randomly seek help from others in the studio."*
> *Student C-Year 2: "Whatever we do within it [the design studio], we do care is the learning environment within it…because my friends are around…making me feel released when I have tough issues…so that I can ask them for help."*

Another reason that made many 2nd-year students to keep the rhythm of engaging in informal learning between peers in their physical design studio was ample living-support facilities around their physical design studio, to fulfil their basic learning and non-study related activities, including the kitchen, toilets, the library, benches, the plotter room, and the lighting studio. For example, some interviewees articulated:

> *Student D-Year 2: "Yeah, we normally come to the studio around 11 am and have lunch in the kitchen nearby. During the process, we would like to have short chats with others on the benches beside the studio, just like normal life in our own accommodations…There are studios for model making, taking photos, and printing and plotting within the building. We don't need to find other places to do those things outside our school."*
> *Student G-Year 2: "The kitchen in front of our studio is a nice place for social activities. We can meet our fellows or some 3rd-year students by accident during the break of each tutorial, and some casual chats just happened within that space."*
> *Student H-Year 2: "Yeah, the kitchen behind our studio is pretty nice. You can have casual chats with your friends there to relax, but I usually go out for lunch with my friends, because you know there are minimal options for food in the vending machine downstairs."*

In addition, due to the rising living cost in houses, especially the electricity and gas bills during the first term of academic year 2022-2023, the number of students who tended to study within their physical design studios for a prolonged period also increased. This phenomenon typically applies to higher-grade home students and others who cannot afford the rent and bills of private student accommodations, since 1st-year students are allocated to live in university students accommodation, within which the bills are

included. For example, some 3rd-year interviewees complained about the difficulties of paying for the increased living cost:

> *Student J-Year 3: "Gosh, the electricity bill in my flat is more than £120 per month per person, even though I spent most of the daytime in our studio to save the cost…The worse is that the temperature of the radiator is lower than that in the last year because I specifically touched it to feel warm, but it did not feel warm enough."*
> *Student K-Year 3: "Yeah, the electricity bill increased dramatically monthly, so I am always worried about it. It makes me have to do some part-time jobs to support my normal living. Otherwise, I will spend the whole day in my design studio to save the cost in the coming winter…Also, the wifi in my house doesn't work, so I come to school to study with good quality of wifi."*

It is known from students' accounts above that students have specific rhythms on engaging in informal learning between peers in different academic years. Specifically, 1st-year students typically organised their peer-to-peer engagements depending on formal timetable activities and learning environments. 2nd-year students typically maintained their peer-to-peer engagements within their physical design studio, due to the design studio learning environment constituted by students themselves and learning-supportive facilities around their physical design studio. 3rd-year students had multiple choices on learning spaces, depending on their learning tasks and living conditions.

Under the theme of "Mutual Accountability", it was notable that some higher-grade students complained that they would like to give up studying architecture due to the peer pressure caused by the "sweating". For example, Student E-Year 2 indicated:

> *Student E-Year 2: "I want to quit studying architecture…so stressful to work in the sweating atmosphere, so I hardly study within the design studio…I normally went to the studio only if I want to check the progress that others got, to adjust mine."*

However, this feeling was not common among 2nd-year students who usually study within physical design studios. By contrast, a considerable number of 3rd-year students claimed that they felt the pressure from each other's "sweating" even though they studied within their physical design studio where many others were present, but they showed different attitudes towards this invisible pressure. Specifically, to make a better portfolio, some students did their utmost to create astonishing design works and outstanding portfolios.

Thus, sometimes someone could suddenly produce a major surprise with his/her design project that astounds everyone else. Because of this, "sweating" created pressure on some architecture students, resulting in more and more achievements and surprises among them. Furthermore, other students also had to be "sweating", striving their hardest and even better than before to outdo others. Accordingly, "sweating" brought peripheral benefits to students' progress and outcomes as students did not receive physical help or suggestions from their peers. For instance, Student A-Year 3 was interviewed, and she complained about the "sweating" around her:

> *Student A-Year 3: "…it's really annoying that they always asked me to have a look at my design work and portfolio. It's final year, you know, so whether I can get a 2:1 or 2:2 degree is decided by my design works' scores directly. I am so afraid that since others got clear about the details of my design work, they would be 'sweating' harder to surpass me… I felt fed up with the high pressure from 1st-year to 3rd-year. I witness that my friends failed to pass each year, and I only felt released rather than relaxed after passing each critique. Until now, I always feel lonely when encountering some tough issues in my design work because my friends are no longer beside me. Although I can ask for help from other fellows, we are rivals, so they will only provide me with a little help or support. Instead, some of them even want to see my portfolio all the time, and I am so afraid that they will plagiarise my design ideas. Anyway, I insisted on studying another discipline after my graduation."*

In contrast, another individual, Student F-Year 3, enjoyed the circumstance of "sweating", and he was even the "sweater" itself. According to several observations from March to May 2022, he usually spent his entire day within the design studio or tutorial space, showing and presenting his design process and details to others, to seeking help from other students. He admitted:

> *Student F-Year 3: "I literally learned a lot from others' support and suggestions since some knowledge was unable to get only by myself."*

However, when Student F-Year 3 was absent, his fellows were interviewed to review his behaviour, and they all complained:

> *Student B-Year 3: "He was so 'sweating'. Do you know that he even did not sleep last night with his weak body to finish some critical parts in the AT? There're a lot of parts we are still working on, but he has almost done them. We don't know how he could make it."*

Student D-Year 3: "The more exaggerated is that he can come to school and keep working today. What a monster he is."
Student G-Year 3: "The key point is that we feel very behindhand since he 'sweat' pretty much."

The accounts above illustrate a negative attitude towards "sweating" environment within physical design studios among some 2nd- and 3rd-year students, even though they knew that "sweating" could peripherally enable them to achieve better design works. Obviously, not every student can endure the high pressure and "sweating" environment within physical design studios. After all, "sweating" can either be motivations or pressures, depending on different individuals. This contrast implies that it is not necessary for students to be present in physical design studios to form a community of practice as the form of a large-scale learning community. Thus, to get rid of the pressure, it was found from some students' accounts that they found alternative measures to maintain their peer-to-peer engagements within alike design studio learning environments, which were constituted by students themselves outside physical design studios. Specifically, under the theme of "Interpretation", students in different academic years found their specific ways to constitute alternative design studio learning environments. For example, 1st-year students typically maintained their alternative design studio learning environments in virtual environments, as indicated by Student A-Year 1.

Student A-Year 1: "There was no opportunity to communicate with others after course and tutorials when I had remote learning in China. I had no idea what others' design process was and the ways to learn from others, which was so helpless. Fortunately, my parents are working in relevant fields, so I could ask for help from them sometimes, but it is still different to do it with peers in good relationships."

Furthermore, Student A-Year 1 and Student C-Year provided more details on constituting their alternative design studio learning environment in Focus Group 1.1.1, 28th April, Thursday 2022:

Student A-Year 1: "The virtual learning initially was not as good as physical one after I study face-to-face, as the frequent change of tutors and the lack of learning environment where people are around."
Student C-Year 1: "Most 1st-year students around me normally communicate with and asks for help from peers via social media rather than face-to-face

peer learning. Even though, I can still grasp the valuable resources and knowledge I need. It is because their design projects and tasks are creative, and there are not enough practical requirements for them, so the students like me just need to search for critical knowledge and resources via social media or public resources in libraries or online, such as Pinterest, ArchDaily, Instagram, and Youtube channels."

It is known from the focus group above that these 1st-year students were still exploring the ways of learning as the form of a community of practice, so they typically engage in informal learning in individual and ask for help from peers via virtual learning measures. Comparatively, Student J-Year 1 indicated his way of maintaining an alternative design studio learning environment within the tutorial space:

Student J-Year 1: "I like working alone, because others are speaking loudly in the design studio, and my table is too small to place learning materials in my own room, but if I have some questions, I would also like to seek help from others studying in the design studio… I only communicate with others when I have specific questions on my design project. For example, I studied in the hybrid study last Wednesday, and I asked a person for some suggestions on my design work. He was working in the design studio."

Compared with 1st-year students, higher-grade ones typically found more ways of constituting alternative design studio learning environment, such as within blended learning environments and the tutorial space as well as other non-timetabled learning spaces on campus. For example, Student G-Year 2 provided an example of maintaining peer-to-peer engagements between her friends and study companions via blended learning methods.

Student G-Year 2: "I once had a group talk with my friend via distance videos. Some of my group members were at the tutorial space, but me and some of my friends were staying at our own homes, so we used the screens within the tutorial space or our laptops to have a hybrid talking. We even often did that during formal tutorials."

Likewise, Student K-Year 3 also indicated his way of maintaining alternative design studio learning environments outside their physical design studio, including virtual environments and non-timetabled learning spaces.

Student K-Year 3: "I can have the full view of our design materials on the Miro, so I can look through all my design ideas, sketches, learning materials, design processes that I uploaded into the Miro… sometimes I need a quiet

place to do some self-study, such as making the physical model and search for reference books in Architecture Library. The hybrid studio and library ensure me to do them in this building. So, I can study here for a whole day."

Accordingly, according to interviews and focus groups from students throughout three academic years, there are several characteristics of the modes of communities of practice constituted by these students. The first one refers to distinct learning groups simultaneously appear within the design studio learning environment. The second one refers to different reactions to "sweating". The last on refers to that some students study within their physical design studio depending on their living conditions.

6.4.3 The Ways that A Joint Enterprise Develop throughout Three Academic Years

It is known from the last two sections above that students in different academic years typically have their specific ways of constituting a joint enterprise, even though these ways are commonly ensured by the design studio learning environment and its alternatives. Specifically, 1st-year students typically constituted a joint enterprise within their physical design studio depending on the structure of the week, learning environments, and even the deadline of submitting the AT1 assignment. Alternatively, they still explored the ways of constituting a joint enterprise outside their physical design studio.

Comparatively, 2nd-year students typically have more specific ways of constituting a joint enterprise within their physical design studios. Specifically, many 2nd-year students typically maintained their peer-to-peer engagements within their physical design studios for a prolonged period every day, and they generated the design studio learning environment full of "sweating". Besides, the tutorial space in the school building, non-timetabled learning spaces on campus and public spaces in student accommodation are all options for constituting a joint enterprise by some other 2nd-year students. For example, the 2nd-Year Chair provided another specific example of students' self-organised studio-like learning environment in their accommodation:

> *2nd-Year Chair: "10 architecture students live in one house. They normally prefer learning together and ask for help from their housemates, as long as they are good friends."*

3rd-year students typically not only have more specific study companions but also have distinct styles of informal learning between peers, so they have more specific ways of constituting a joint enterprise in more conditions. For example, some 3rd-year students immersed in the design studio learning environment within physical design studios where a lot of people around, but they just worked on their own learning and non-study related activities; Some students also worked within their physical design studio, but they just came when the deadline was approaching; Some students, instead, typically engaged in informal learning with specific study companions within the tutorial space, and they casually went to their physical design studio to check others' design process. Even though, some 3rd-year students tried their best to get rid of engaging in informal learning between peers within the design studio learning environment wherever within or outside physical design studios after three years' architectural learning under the pressure brought by dramatic "sweating".

6.5 Summary: The Ways That Communities of Practice Progress throughout Academic Years

This chapter presents the further findings from the second-phase study, addressing the third objective "to identify the ways that communities of practice develop throughout different academic years". Specifically, by investigating the informal learning activities between peers among undergraduate architecture students at the Welsh School of Architecture, this chapter finds that the established communities of practice exhibit different characteristics among the three academic years. The main reasons for this include the contents and comprehension of design projects, the studio environment, historical contexts, social activities organised by students, the learning environments within the school building of the Welsh School of Architecture, personal characteristics, etc. Specifically, students' requirements and acquisitions of architecture learning are

totally different in three academic years, so the communities of practice constituted by students are also different throughout these three academic years. In general, lower-grade students need basic skills in design and drawing to get accustomed to the contents and process of an entire design project; upper-grade students need more comprehensive and specific knowledge and skills to train their design and architectural abilities. Even though the modes of students' informal learning between peers are somewhat distinct among the three academic years in the Welsh School of Architecture, those learning experiences have common characteristics. For instance, they all have a common inclination to admit that it would be better to grasp necessary knowledge through learning within the environment where other companions are present, which indicates that they have the willingness to study within the design studio learning environment of physical design studios or other non-timetabled learning places.

To reveal the development of modes of architecture students' communities of practice across the three academic years, Table 16**Error! Reference source not found.** summarises the characteristics of those learning experiences, based on the themes "A Shared Repertoire", "Mutual Engagement", and "A Joint Enterprise".

Table 16 The Development of The Community of Practice Throughout Three Academic Years

	Students' Preference	Community mode	Attributes of Communities of Practice		
			A Shared Repertoire	Mutual Engagement	A Joint Enterprise
Year 1	Within Physical Design Studios	The learning environment where knowledge and regulation of architectural technology is easily accessible. This usually occurred some days before the deadline of submitting assignments (Modelling/AT).	Multiple small-scale learning groups within the physical design studio. Students typically focus on their own tasks and occasionally discuss with others through face-to-face contact methods within the learning community.	Students with the same race and interests as well as within the same group work tend to work in the same learning group. After several times of face-to-face informal learning activities between peers, they have realised the benefits of working between peers.	Students engage with peers through face-to-face contact methods typically within their own learning groups.	Students have the common sense of constituting their learning groups within the physical design studio, but interactions between these learning groups are limited.
	Outside Physical Design Studios	The learning environment where is relatively quiet. Students can feel relatively lesser peer-pressures from others.	Usually, small-scale learning groups organised by close friends. Students typically focus on their own tasks and occasionally seek help from others mainly through distance contact methods within these learning groups.	Students with the same race and interests as well as within the same group work tend to work in the same learning group. After several times of distance and face-to-face informal learning activities between peers, they have realised the benefits of working between peers.	Students engage with others by distance contact methods within their own learning groups.	Students have the sense of maintaining their specific learning groups online.
Year 2	Within Physical Design Studios	The design studio learning environment where people are present. Within this environment, students can acquire inspirations and motivations from others to stimulate their own learning. Meanwhile, various	An entire big-scale learning community formed by individuals and some small-scale learning groups. Students typically focus on their own tasks and occasionally discuss with others within the learning community.	Many students grasp the sense of working together and "sweating" within physical design studios outside formal timetable activities. Besides, some students generate peer-to-peer engagements with others by social activities.	Students engage with peers through face-to-face contact methods not only within their own learning groups but also within the whole learning community.	Students have the common sense of constituting an entire learning community within the physical design studio, and interactions between these learning groups are pronounced, especially checking others' work process and "sweating".

		learning activities and "sweating" generated from them form the "studio culture".				
	Outside Physical Design Studios	The design studio learning environment where is relatively quiet. Students can feel relatively lesser "sweating" from others.	Usually, small-scale learning groups organised by close friends, established study companions, or individual learning. Sometimes, a large-scale learning community established by many individuals who live in the same house. Students typically focus on their own tasks and occasionally discuss with others through face-to-face or distance contact methods within these learning groups.	Students with the same race and interests as well as within the same group work tend to work in the same learning group. They are afraid of the pressure brought by "sweating"	Students engage with others by both face-to-face and distance contact methods within not only their learning groups but also the whole learning community.	Students have the sense of maintaining their specific learning groups in the tutorial space, other non-timetabled learning spaces on campus, public spaces in student accommodation, their own rooms.
Year 3	Within Physical Design Studios	The learning environment where everything is present, forming a "messy" environment. Within the environment, students can easily acquire available learning materials to support their own learning.	An entire big-scale learning community formed by some separated small-scale learning groups. Students typically focus on their own tasks and occasionally discuss with others within their learning groups.	Students tend to study with specific friends or study companions after three years' learning. They behave dramatic "sweating", but some of them are fed up with it.	Students engage with peers through face-to-face or distance contact methods depending on if it is closing to the deadline.	Students have the common sense of constituting their learning groups within the physical design studio, and interactions and "sweating" are pronounced.

Outside Physical Design Studios	The learning environment where is relatively quiet. Students can feel relatively lesser “sweating” and peer-pressures from others.	Usually, small-scale learning groups organised by close friends, random study companions, or individual learning within the tutorial space and other non-timetabled learning spaces. Students typically focus on their own tasks and occasionally discuss with others through face-to-face or distance contact methods within these learning groups.	Students with the same race and interests as well as within the same group work tend to work in the same learning group. Someone else can also join these learning groups.	Students engage with others by face-to-face and distance contact methods.	Students have the sense of maintaining their specific learning groups in the tutorial space, other non-timetabled learning spaces on campus, public spaces in student accommodation, and their own rooms.

CHAPTER SEVEN

The Model of Communities of Practice Modes Constituted by Architecture Students' Informal Learning between Peers

7.1 Introduction

The last two chapters analysed data collected from volunteered undergraduate architecture students at the Welsh School of Architecture, Cardiff University. Chapter 5 analysed data based on three attributes of communities of practice, which are a shared repertoire, mutual engagement, and a joint enterprise, summarising general characteristics of students' informal learning between peers and the ways that such learning constitute communities of practice. Subsequently, Chapter 6 analysed data based on students' academic years, distinguishing specific ways that students constitute communities of practice in specific academic years.

This chapter summarises the model of communities of practice based on the findings of the last two chapters. Specifically, Section 7.2 introduces the matrix of the variables of determining the community of practice based on three attributes of the community of practice. Section 7.3 elaborates on three main modes of communities of practice constituted by architecture students' informal learning between peers throughout three academic years. Section 7.4 elaborates on the modes of communities of practice constituted by architecture students' informal learning between peers in specific academic years. This chapter ends with the model depicting the three main modes of communities of practice in the matrix stated above.

7.2 The Matrix of the Variables of Determining the Community of Practice

The last two chapters summarised the specific communities of practice constituted by architecture students' informal learning between peers, via the lens of three attributes of

the community of practice, which are a shared repertoire, mutual engagement, and a joint enterprise. Accordingly, a shared repertoire results from students' peer-to-peer engagements and the design studio learning environment. Mutual engagement is regarded as the peer-to-peer engagements resulting from students' various informal learning activities within the design studio learning environment. A joint enterprise refers to the design studio learning environment and its alternatives within and outside physical design studios, including the tutorial spaces, other timetabled learning spaces on and off campus, students' own home, and even virtual learning environments.

According to the characteristics above, it is summarised that there are two variables, which are the level of interactions (from high or low interactions) and measures of contact between individuals (students' preferences for learning in remote or face-to-face ways), determining the community of practice constituted by students (dependent variables). Figure 35 illustrates the matrix of variables of architecture students' informal learning experiences between peers.

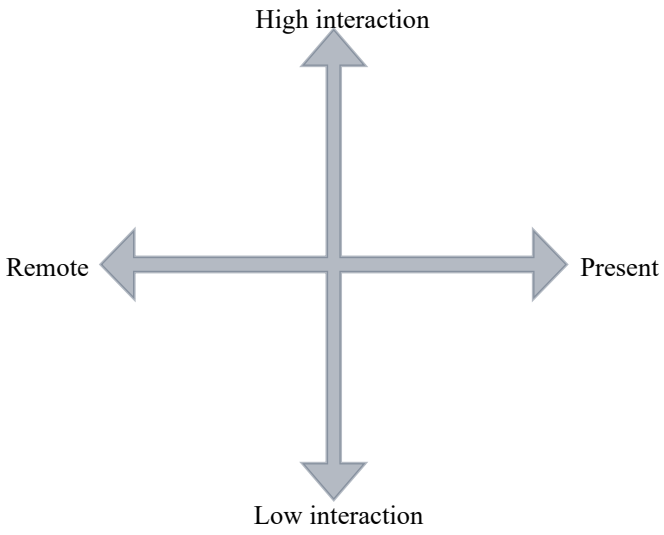

Figure 35 The Matrix of the Variables of Determining the Community of Practice

7.3 Three Main Modes of Communities of Practice Constituted by Architecture Students' Informal Learning between Peers

Based on the thematic characteristics of architecture students' informal learning between peers, this chapter classified three main modes of communities of practice, which are

"homogenous", "dispersive", and "intermodal" ones. Figure 36 illustrates the generation of these three main modes of communities of practice. To distinguish these three modes of communities of practice, the mode of homogenous communities of practice is marked as Blue, the mode of dispersive communities of practice is marked as Red, and the mode of intermodal communities of practice is marked as Green. Specifically, within homogenous communities of practice, students can form a large-scale learning community with a diverse shared repertoire, and they can contact others by diverse mutual engagement, but they need to reform homogenous communities of practice by a large joint enterprise. Within dispersive communities of practice, students can form a small-scale learning group with a settled shared repertoire, and they can contact others by limited mutual engagement, while they can reform dispersive communities of practice just by a small joint enterprise. Within intermodal communities of practice, students can form a no-specific-scale learning guerilla with a random shared repertoire, and they can contact others by random mutual engagement, and they can also reform intermodal communities of practice just by a random joint enterprise.

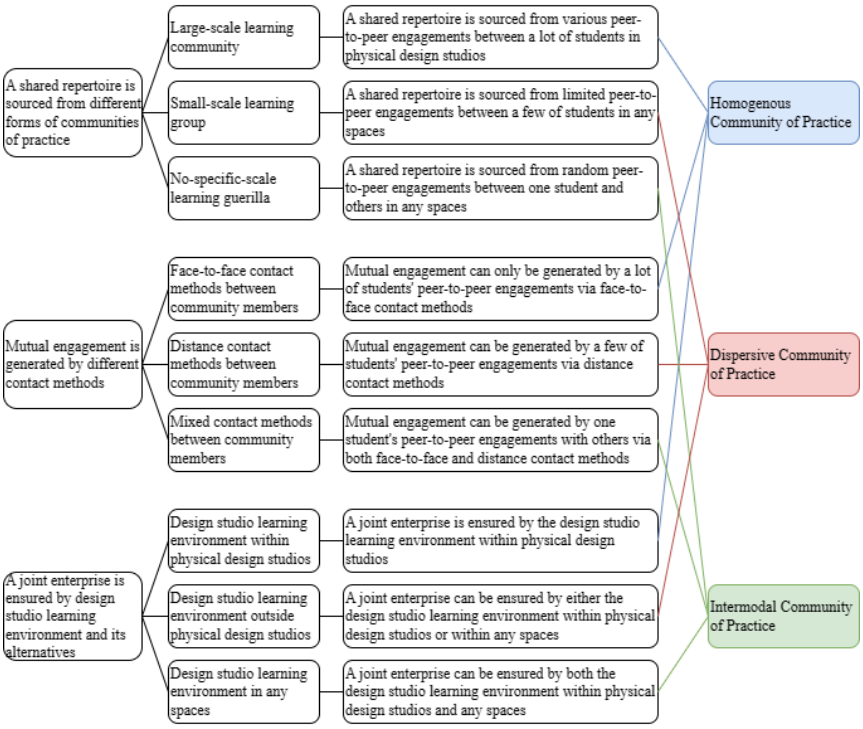

Figure 36 The Generation of Specific Communities of Practice Constituted by Specific Forms of Informal Learning between Peers

Table 17 illustrates the description of such communities of practice. The first horizontal row is filled with a gradient complementary colour strip, within which the community of practice that is more dispersive tends to be red, that which is more intermodal tends to be green, and that which is more homogenous tends to be blue. The first vertical column is categorised by three attributes of the community of practice, which are a shared repertoire, mutual engagement, and a joint enterprise. It can be inferred from Table 17 that the design studio learning environment serves as the core role among these modes of communities of practice. Typically, the homogenous community of practice can only be established in physical design studios. Comparatively, the formation of the dispersive community of practice has relatively fewer constraints, suggesting that this community of practice can be established both within and outside physical design studios, whereas the community members still constitute a design studio learning environment. The members of the intermodal community of practice typically engage in other two modes of communities of practice, so the informal learning between peers of these members can typically engage in design studio learning environments within other two modes.

Table 17 The Definition of Each Specific Community of Practice and Their Attributes

		Dispersive	Intermodal	Homogenous
A shared repertoire	Students' Preference – Peer-to-peer Engagements	Students mainly communicate with others on social media. This learning mode is basically based on friendships between students. Students prefer to study with their friends or specific study fellows learning on a small scale (normally 2-8 people), so they have relatively limited peer-to-peer engagements.	Students have no preference on studying with their friends or others. Students have no preferences on the specific type of informal learning between peers. They can communicate with others by social media and keep a "soft interaction" between others in the design studio Their informal learning between peers is maintained by random peer-to-peer engagements	Students typically keep a "soft interaction" between others when they study in the design studio. Students prefer to communicate with casual persons either they are familiar with or not, so there are various peer-to-peer engagements between these students.
	Community mode – The Learning Environment Generated from Peer-to-peer Engagements	The informal learning between peer students forms small-scale learning groups. This learning mode can be formed in either within or outside the design studio. Students typically have common goals, interests, and habitus, so a shared repertoire is formed by these common characteristics.	The informal learning between peer students forms either small-scale learning groups or a large-scale learning community. Students have common characteristics with their friends, and they also enjoy in the learning environment in the design studio. Thus, a shared repertoire is casually organised within no specific learning environment.	The informal learning between peer students forms a large-scale learning community, which is basically formed in physical design studios. Students usually engage in their own tasks and occasionally communicate with others in the physical design studio, so a shared repertoire is formed by this learning environment.
Mutual engagement	Students' Preference – Mode of Contact	Students have multiple options to choose their learning spaces and contact methods, especially contacting in remote ways when they work at home.	Students have no preference on the specific type of learning environments and contact methods, and some of those students are even intermodal representatives to connect other individuals who like learning in remote or present ways.	Students' interactions are mainly based on face-to-face contact methods, generating mutual engagement which can only be achieved by physical measures, such as doing physical models together and talking about the design ideas based on the physical model which they made.
	Community mode – The Learning Environment Suitable for The	Mutual engagement is maintained by means of physical contact in different dispersive environments, such as learning at home and asking for help from others via social media.	The mutual engagement is maintained in no specific environment, which means that students' interactions can happen within a homogenous environment, such as the physical	The mutual engagement is maintained within a homogenous environment, typically happening within the physical design studio.

			design studio, or a dispersive environment, such as students' own rooms.	
	Specific Mode of Contact Students' Preference – The Design Studio Learning Environment	Students' informal learning experiences happen within dispersive environments, such as non-timetabled learning spaces outside physical design studios.	Students have no preference on the design studio learning environment within or outside physical design studios.	Students' various interactions generate a joint enterprise as the form of a whole learning community only happened within the design studio learning environment in physical design studios.
A joint enterprise	Community mode – The Learning Environment Generating Design studio learning environment and Its Alternatives	A joint enterprise is maintained in the form of small learning groups in different dispersive environments, such as the small learning unit within the tutorial space, public learning space within the student accommodation, and even students' own homes.	A joint enterprise is not restricted within the specific design studio learning environment or other dispersive contexts, and students' informal learning form can be either engaged in small-scale groups or a large-scale community.	A joint enterprise is maintained within a homogenous environment where a lot of students are present, specifically the physical design studio.

7.4 Communities of Practice in Different Academic Years

Chapter 6 elaborates on the mutual characteristics of communities of practice among 1st-, 2nd-, and 3rd-academic year students. The specific modes and characteristics of informal learning activities between peers in three academic years are elaborated in Table 18.

Table 18 Learning and Non-Study Related Activities as well as Modes of Communities of Practice in Three Academic Years

	Learning and Non-Study Related Activities	Mode of Communities of Practice
1st-year students	1st-year students are newcomers, so the assignments and design projects for 1st-year students are more conceptual and innovative. They initially acquire design ideas, and technological and other design-related knowledge some online resources. Subsequently, they gradually realised the benefits of learning from peers, but they still work with specific individuals with limited sense of "sweating".	Typically, dispersive communities of practice wherever within or outside physical design studios.
2nd-year students	2nd-year students are assigned with small-scale practical architectural projects, which are no longer simple and conceptual. Besides, due to some social activities, they have opportunities to get familiar with many others, in further to constitute their peer-to-peer engagements. Hence, many 2nd-year students have the sense of learning with peers in the design studio learning environment where they can acquire benefits to their own learning. In the meanwhile, they recognise the sense of "sweating" between peers when they work within the design studio learning environment of their physical design studio.	Typically, a homogenous community of practice within physical design studios.
3rd-year students	3rd-year students are assigned with large-scale architectural projects, which require them to consider more factors influencing the design. In addition, after three years' learning, many of them have found very specific friends and study companions for engaging in their very styles of informal learning between peers. They tend to form several small-scale learning groups due to the dramatic "sweating" within the design studio learning environment of their physical design studio.	Typically, a homogenous community of practice constituted by a cohort of dispersive and intermodal communities of practice spreading in the physical design studio or outside it.

To obtain a clear understanding of these communities of practice in three academic years, Table 19 elaborates on the details and characteristics of some students and illustrates the relationships between communities of practice constituted by these students' informal learning between peers. Since the general characteristics of architecture students' informal learning between peers have been unveiled, it can be found from Table 19 that modes of students' informal learning activities and communities of practice in different academic years typically have same characteristics.

Table 19 Informal Learning Activities between Peers of Some Typical Students and Their Communities of Practice

Participants	Informal learning activities between peers	Type of community of practice
Student H-Year 1	She and her specific friend tend to do peer learning within the tutorial space, but they feel disturbed by formal tutorials in this space. Thus, they think that the quiet and shared learning space is insufficient within the school building.	Dispersive
Student B-Year 1	He usually studies by himself at home, and he always searches for learning materials from online resources by himself. Even though, he and his three friends actively constitute a specific learning group to do the AT1 assignment for several days close to the deadline.	Dispersive
Student J-Year 1	He usually studies in the tutorial space three to four days a week, because the table within the tutorial spaces is big enough to place his drawings, sketches, and laptop, but the table in his own room is too small to place those learning materials.	Dispersive
Student E-Year 1	She is a close friend of Student D-Year 1, and she hardly goes to the studio to study as well. Basically, she also studies at home and asks for help from her friends if she encounters some problems.	Dispersive
Student F-Year 1	He only comes to the physical design studio to do AT1 assignments with his friends close to the deadline. However, he has no passion for getting a high grade, and the reason he studies with peers is that he wants to ask for help with technological knowledge from others directly.	Dispersive
Student F-Year 3	He has some specific friends for engaging in informal learning wherever within the physical design studio and the tutorial space. However, he dislikes the environment where a lot of people are around within the physical design studio, because he is easy to be disturbed by people's talk and noises made by others.	Dispersive
Student D-Year 1	He hardly studies at the physical design studio, because he has no sense of learning as the form of peers asking for help with design knowledge. Nevertheless, he and his friends complete AT1 assignments together at the physical design studio just before the deadline for several days.	Intermodal
Student F-Year 2	She usually studies at home, but she still insists on going to the physical design studio frequently to check others' work processes and get inspiration from others. Her friends also ask for her suggestions on their design projects when she goes to the physical design studio.	Intermodal
Student G-Year 2	She has no preference for learning spaces, but she tends to study at home, since the commuting time takes lone. Nevertheless, she sometimes studies at the physical design studio when the weather is good.	Intermodal

Student E-Year 3	She normally tends to study at home, because she wants to save time on dressing up and commuting. When it is close to the deadline, her friends invite her to study together, but she feels sweating.	Intermodal
Student G-Year 3	He usually studies at home because he highly relies on the high-tech facilities within it, such as multiple screens and high-configured computers. Nevertheless, he still comes to study with his friends close to the deadline, to get some practical advice and suggestions.	Intermodal
Student A-Year 2	He usually study in the physical design studio with his friend after lunch, and they left the studio in the late afternoon. He is usually immersed in the design studio learning environment where a lot of people are around without frequent communication with others.	Homogenous
Student C-Year 2	He is one of the learning fellows of Student B-Year 2. He usually comes to the physical design studio very early and has lunch and dinner within it. Thus, he and his fellows have a tacit understanding with each other to buy food.	Homogenous
Student D-Year 2	He is keen on studying within the physical design studio, where his friends are also sitting around his site. He confesses that he and his friends around may not do design work, but they all enjoy the homogenous environment where they can see everyone and their working process.	Homogenous
Student K-Year 2	She is keen on studying within the physical design studio with her friend, and she thinks that the design studio learning environment where learning materials are around to look around is helpful to her own learning creativity.	Homogenous
Student K-Year 3	He is always actively learning new ideas and knowledge from multiple sources to enrich his design project, so he can always present fresh and creative design products to others. His friends always say that he is so sweating, encouraging them more sweating than him.	Homogenous
Student I-Year 3	He always studies with his two specific study companions within the physical design studio to ask for advice and suggestions for his design project. He believes that this method inspires him with a lot of ideas for his design project.	Homogenous
Student L-Year 3	He and his friends were all studying within the physical design studio two weeks before the desk crit. To save time, they asked him to help fill the water for them. That has been a daily routine for them all.	Homogenous

7.5 Summary

Since three main modes of communities of practice were found in this thesis, for a more lucid understanding of the relationship among these three modes of communities of practice, Figure 37 presents these three modes of communities of practice within the matrix of variables of communities of practice constituted by architecture students' informal learning between peers outside formal timetable activities. Specifically, the homogenous community of practice occupies the first and second quadrants, in which students have relatively more interactions and informal learning between peers is achieved through face-to-face methods; The dispersive community of practice occupies the third and fourth quadrants, in which students have relatively fewer interaction and informal learning between peers is achieved through remote methods; The intermodal community of practice acts as the bridge connecting the community members of these two communities of practice. To distinguish different quadrant by the modes of the community of practice, the homogenous mode is marked as Blue colour, the dispersive mode is marked as Red colour, and the central Green part means the intermodal mode that bridges each quadrant. The next chapter will discuss the findings of this thesis and related previous studies.

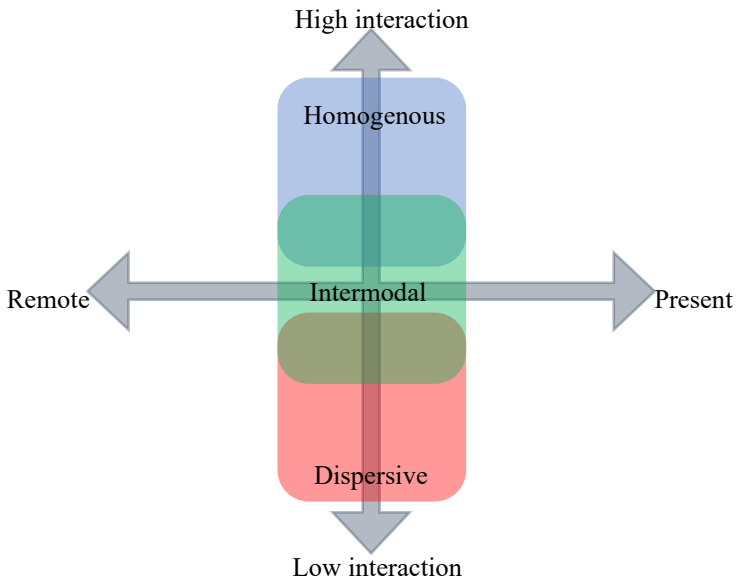

Figure 37 The Matrix of Three Main Communities of Practice Constituted by Students' Informal Learning between Peers

CHAPTER EIGHT

The Thematic Modes of Architecture Students' Informal Learning by Lens of the Community of Practice

8.1 Introduction

By investigating architecture students' informal learning experiences between peers outside formal timetable activities, this thesis uncovers the ways that communities of practice constituted by architecture students within the design studio learning environment under various circumstances. Specifically, in the previous two chapters, it is identified that a large number of architecture students get accustomed to or constitute the design studio learning environment in other places outside their physical design studios, even when they are reluctant to visit physical design studios frequently due to some personal and environmental conditions. This chapter discusses the findings from this thesis and previous related studies to explore whether there are similarities and novelties. The following sections discuss findings from this thesis and previous related studies, to explore differences and novelties of the ways of architecture students' informal learning between peers, through the lens of three attributes of the community of practice, which are a shared repertoire, mutual engagement, and a joint enterprise. It is notable that the theory of these attributes was initially pointed out by Lave and Wenger (1991), and subsequent researchers generally accept and apply this theory in their studies of the community of practice (such as Ding and Ng 2010, Deakin et al. 2011, Valenti and Sutton 2020). This chapter ends with a summary of the discussion, indicating the core role of the design studio learning environment in constituting the community of practice.

8.2 A Shared Repertoire

Wenger (1998) indicated that a shared repertoire typically refers to the common culture and language, encompassing stories, artefacts, styles, tools, actions, historical events,

discourses, concepts, etc. that exists between members of the community of practice. In my thesis, a shared repertoire regarding architecture students means the common language, cultural basis, interests, habitus, jargon, and learning and non-study related activities, which have been developed by these students over time, within a specific informal learning group or an informal learning community. In addition, my thesis concentrates on such a shared repertoire between peers outside formal timetable activities, which means that the constitution of these communal characteristics is without the influence of studio tutors and programmes. It is discovered in my thesis that, students, who can generate peer-to-peer engagements outside formal timetable activities, facilitate the generation of such a shared repertoire between peers to some extent. This finding argues against perspective on a shared repertoire of architecture students from some other related studies, within which a shared repertoire of architecture students was previously regarded as the formal programme and activities that occurred between students and the studio tutor, which typically belonged to the formal timetable activities. For example, Schön (1987) regarded the physical design studio as a culture where students and instructors collaborate and a programme of activity.

Due to the theory of Schön (1987), many other relative studies mainly investigate learning and teaching activities within the formal timetable activities (such as Attoe and Mugerauer 1991; Uluoglu 2000; Kvan 2001; Morton 2012; Vosinakis and Koutsabasis 2013; Pektaş 2015; Williams 2017; Marshalsey and Sclater 2020; Fleischmann 2019; Park 2020; Alnusairat et al. 2021). Thus, it was used to automatically understand that students' learning activities within the entire physical design studio within the formal timetable was regarded as the community of practice. Unlike that concept, my thesis categorised architecture students' communities of practice into distinct modes based on mainly three forms of informal learning between peers outside formal timetable activities, which are learning communities on a large scale, learning groups on a small scale, and learning guerillas on no-specific scales (as indicated in Section 5.2.3). Whatever forms of informal learning, they are all maintained by students' peer-to-peer engagements. These

findings extended the view of Boud et al. (2001) and Topping (2005), who all pointed out that learning between peers is regarded as small-group activities where status-equal or matched companions actively assist and support each other formally and informally. This finding also demonstrated the statement of Williams (2017), who indicated that for some students, the peer-to-peer engagements through the design studio learning environment was a fluid process that occurred over the course of a day or week; for others, it was a ritualised process of discrete visits made solely to maintain a peripheral peer-to-peer engagement with the design studio community, and one that had to be reconciled with the need to proceed with work elsewhere.

Specific peer-to-peer engagements between architecture students were found in my thesis. For example, some students, who study within physical design studios, invite others to offer suggestions for their design projects, and some other students seek help from their study companions or others to teach the techniques of architectural software. Through the suggestions and assistance from peers, the most significant gains for those support seekers are the technological knowledge. This situation especially applies to 1st-year students, since they typically generated peer-to-peer engagements when they needed to deal with Architectural Technology (AT1) assignment (see Section 6.2). These findings demonstrate the perspectives of some related studies. For instance, Armstrong and Allwinkle (2017) emphasised that technological knowledge can only be required from outside resources, such as websites and people learning in relative disciplines, so, as stated by Wienand (2013), it differs from design skills which can be inspired by usual stuff around us.

Furthermore, the findings of my thesis summarised that the main challenges and difficulties of generating peer-to-peer engagements between students are the need for more effective communication and collaboration, physical learning settings, and learning skills support when outside formal timetable activities, especially within virtual environments (see Section 5.3). Specifically, it was found that many study participants complained about their difficulties to maintain their peer-to-peer engagements between

friends and study companions within the virtual environments. These findings extended the perspective of Cuff (1991) that most architecture students lack communication and interpersonal skills. Thus, to constitute a successful community of practice outside formal timetable activities, the peer-to-peer engagement between students need to be strengthened, and the design studio learning environment where learning materials and peers are present should be modified when students are learning in other non-timetabled learning spaces and their own homes.

In addition, through observations and interviews in different academic years in my thesis, it was found that 2nd- and 3rd-year students were more willing to actively engage in informal learning with their friends or specific study companions. Specifically, since most of 2nd- and 3rd-year students have built peer-to-peer engagements with specific individuals due to mutual races and interests as well as social activities, they typically maintain these peer-to-peer engagements as the form of a large-scale learning community or several small-scale learning groups outside their formal timetable activities (see Section 6.2). Thus, without closed and stable peer-to-peer engagements, which were not built in a short time, a considerable number of students lost their focus on cultivating their interests and ambitions in architecture learning, especially when they were learning in virtual environments. This finding identified statements of many other studies. For example, Iranmanesh and Onur (2021) indicated that the 3rd- and 4th-year students had more time to build peer-to-peer engagements among themselves compared with 1st- and 2nd-year students. Thus, even though architecture students' learning activities are easy to be engaged in virtual environments, they are still difficult to be facilitated within the virtual learning environments because the bonds between students are weakened in virtual measures.

8.3 Mutual Engagement

Wenger (1998) indicated that mutual engagement refers to the relationships that bind community members as a unity. In my thesis, it is found that many architecture students have the sense of maintaining peer-to-peer engagements by engaging in various informal

learning activities between peers, such as drawing and making models as a group, seeking providing help, and conducting group work together, with specific people within the specific design studio learning environment. This sense is regarded as mutual engagement between these students in my thesis. This finding proved the statement of Cuff (1991) that architecture learning highly depends on mutual interactions among different individuals, especially face-to-face contact.

However, due to the statement of Cuff (1991), indicating that there has not yet been a systematic pedagogy to cultivate architecture students' skills of communication and interactions in most architecture schools, many other related studies only focused on engagements, which are organised within the formal timetable activities, between students and the tutor or only among students themselves (such as Attoe and Mugerauer 1991; Uluoglu 2000; Kvan 2001; Morton 2012; Vosinakis and Koutsabasis 2013; Pektaş 2015; Marshalsey and Sclater 2020; Fleischmann 2019; Park 2020; Alnusairat et al. 2021). In contrast, my thesis focused on students' mutual engagements outside the formal timetable activities, providing the views and stories of some sample architecture students' mutual engagement when engaged in different learning environments, and analysing the general characteristics and attributes of such mutual engagement. It was mainly found that mutual engagement was different when generated by face-to-face and distance contact methods.

Regarding face-to-face contact methods, mutual engagement is determined by the design studio learning environment not only within physical design studios but also outside them, such as the tutorial space, non-timetabled learning spaces on campus, public spaces in student accommodations, and even at home (see Section 5.3). Specifically, within such spaces, students could construct specific design studio learning environments where study companions and learning materials were around, obtaining creative ideas more readily, and comparing others' artefacts with their own to see if they can be inspired by others' ideas or works. The findings of my thesis extended findings of previous studies about learning between peers within the design studio learning environments of physical design

studios. For example, as the argument of Shreeve (2007), within design-related disciplines, the characteristics of a community of practice model can be reflected in the provision of spaces of physical design studios for learning by doing, for material engagement, and for the exchange of practices between students and tutors as well as between students themselves.

Regarding the distance contact methods, architectural education shifted to virtual environments during the COVID-19 period, and the mutual engagement between architecture students was also transformed into virtual means. In virtual environments, such engagement should theoretically be maintained through alternative measures to ensure normal architecture learning experiences. Just as indicated by some previous literature (such as Vosinakis and Koutsabasis 2013; Jones and Dewberry 2013; Yu et al. 2022 in Section 2.3.3), students could still share their learning materials, design thinking, and design practice with their peers by relative digital applications of architecture and increasingly distant professional collaborations, including virtual design studio and virtual communication tools for students' interactions from different disciplines, within the formal timetable. By contrast, my thesis found that it was somewhat different to achieve architecture students' mutual engagement in virtual environment when they were outside formal timetable activities. Specifically, it was found that many students had similar attitudes towards preferring to undertake informal learning between peers within the physical design studio learning environment, since the lack of face-to-face contacts still generated negative effects to students' design progresses and outcomes when they were engaging in informal learning in remote methods, such as loneliness, confusion, lack of motivation, etc (see Section 5.3.2). This finding identified the statement of some previous studies which found that architecture students lacked peer-to-peer contacts with others online due to the virtual design studio learning environment during the COVID-19 pandemic (such as Marshalsey and Sclater 2020; Komarzyńska-Świeściak et al. 2021 in Section 2.3.3).

Although generating such mutual engagement by face-to-face contact methods can bring benefits to architecture students' own learning, some students in my thesis, instead, indicated that they typically preferred to maintain their peer-to-peer engagements with friends by distance contact methods, such as messaging on social media when they encountered some tough tasks outside their formal timetable activities (see Section 5.3.2). This finding identified the statement of some previous studies researching synchronous and asynchronous learning opportunities in the community of practice. For example, as indicated by Doherty and Abdullah (2024), beyond formal timetable sessions, students were suggested to improve themselves by asynchronous social media messaging, to avoid some difficulties caused by synchronous sessions. Furthermore, my thesis found that, even after the "work from home" period due to the COVID-19, students were allowed to come back to the physical design studio to study with others face-to-face, but some of them were still reluctant to study within it outside their formal timetable activities, even though they were aware of the benefits of informal learning between peers face-to-face (see Section 5.2.3). This finding identified the statement of Núñez-Andrés et al. (2022), indicating that many students had no feelings of getting improved even though they experienced a course under peer tutoring.

Accordingly, the mutual engagement between architecture students is somewhat different when they have face-to-face or distance contacts, and it may also vary within different learning environments, whether within physical design studios, other non-timetabled learning places, or even virtual environments. In a word, without a design studio learning environment where students can maintain their peer-to-peer engagements, there are literal difficulties of generating mutual engagement. As indicated by Williams (2017) that learning within the community of practice requires both a social dimension and a material practising dimension, instead, the virtual environment disabled the presence of other students and the right materials, equipment, and spaces, which are only reliable in physical design studios.

8.4 A Joint Enterprise

Wenger (1998) proposed that a joint enterprise emerges from a collective negotiation process that reflects the full complexity of mutual engagement. In this thesis, a joint enterprise can be regarded as the design studio environment where architecture students generate a shared repertoire and mutual engagement. My thesis builds on this theory and extends the understanding of the design studio learning environment by many other studies, which regarded the design studio learning environment as a cultural context where different individuals are able to express their experiences and abilities, regardless of what they have and desire, at any place and time (as indicated by Ceylan et al. 2021; Dutton 1987; Lueth 2008; Koch et al. 2002; Williams 2017 in Section 2.3.1). The findings from my thesis indicated that the significance of the design studio learning environment to study participants is the environment where various people and learning materials are present to obtain inspiration and motivation whenever and wherever necessary rather than the space and the physical context within physical design studios. Thus, architecture students have the tendency to constitute or join a unique design studio learning environment organised by their friends and study companions wherever within or outside physical design studios (see Sections 5.4.1 and 5.4.2). This finding identified the statement of Nicol and Pilling (2000), who indicated that architecture students' learning activities between peers usually occur in the design studio learning environment where people and learning materials are accessible and within reach.

Some other studies have discovered that, compared to the physical design studio, a virtual learning environment provides students with the space for informal learning activities between peers with limited hierarchical relationships from the studio tutor, and it resolves the limitations of space and time within the physical design studio (as indicated by Ceylan et al. 2021; Alnusairat et al. 2021; Yu 2022 in Sections 2.3.2 and 2.3.3). It is also found by the investigation of Williams (2017) that students would be more energetic and enthusiastic about developing the community of practice without hierarchies. However, the findings my thesis revealed that the virtual learning environment weakens the

informal learning between peers within the design studio learning environment (see Section 5.3.2). To address the issue, some students found alternative ways to engage in informal learning between their study companions and constitute a similar design studio learning environment within their own homes (see Section 5.4.2). Furthermore, my thesis further found that blended-learning methods existed outside formal timetable activities since the "work from home" period ended, and some students even communicated with others via social media even though they were studying in the physical design studio (see Sections 5.4.1 and 6.4.2). Similarly, some previous studies (such as Pektaş 2015) designed the blended-learning model to keep a complete loop of design projects in virtual learning environments.

To constitute design studio learning environments, Koch et al. (2002) indicated that design learning holds the main position due to the unique learning activities and experiences of design learning compared with learning behaviours in other disciplines. Specifically, as stated in some other related studies, design learning closely adheres to the cycle of interactive and ongoing feedback (Fleischmann 2019), identifying that social interactions, active learning, and social engagement (Lee 2006) play the primary role in the process of design learning (Kvan 2001; Nicol and Macfarlane-Dick 2006). In my thesis, the findings demonstrated and extended such theories regarding informal design learning. For example, my thesis revealed that the “sweating” between students within the design studio learning environment outside formal timetable activities could not only motivate many students’ progress on design learning but also prevented some students from actively engaging in informal learning between peers (as indicated in Sections 5.2.2 and 5.4.2), which previous studies did not specifically research. It can be summarised that the design studio learning environment enables these students to maintain a joint enterprise. By contrast, without the design studio learning environment, students are disconnected by a joint enterprise.

8.5 The Core Role of the Design Studio Learning Environment in Constituting Communities of Practice

Some previous researchers introduced the community of practice into architectural pedagogy to inspire architecture students' initiatives on informal learning between peers (as indicated by Tunçer and Sariyildiz 2010; Williams 2017; Morton 2012; Tummons 2014 in Section 2.3.1). However, Williams (2017) claimed that architecture students' learning is hard to be observed and evaluated by tutors outside formal timetable activities. Thus, most previous studies mainly focus on the ways that students constitute communities of practice as instructed by studio tutors within formal timetable activities (such as Attoe and Mugerauer 1991; Uluoglu 2000; Kvan 2001; Morton 2012; Vosinakis and Koutsabasis 2013; Pektaş 2015; Marshalsey and Sclater 2020; Fleischmann 2019; Park 2020; Alnusairat et al. 2021). My research extended those findings to explore the ways of constitution of communities of practice without studio tutors' supervision outside architecture students' formal timetable activities. Specifically, students' informal learning activities between peers are regarded as the elements of constituting the community of practice. It was found by study participants that a community of practice might be constituted by architecture students within or outside physical design studios, but wherever it appears it always needs a design studio learning environment (see Section 5.4). For example, even during the "work from home" period, some students constituted similar design studio learning environments, encompassing physical contexts and working with study companions together, to maintain their inspiration and motivation. Thus, the design studio learning environment, where people are surrounded by learning materials and working on their own learning and other tasks but occasionally communicate with others, was regarded as the core role in communities of practice.

Accordingly, my thesis identified three main modes of communities of practice, which are homogenous, dispersive, and intermodal, constituted by architecture students' informal learning between peers (see Section 7.2). The explanation and characteristics of

all these three modes of communities of practice are presented in Table 20. This finding differs from the statement of Morton (2012), who argued that participation in the design studio learning environment does not follow a discrete community of practice model, and every student may actively engage in communities of practice that may not be practical for others. In contrast, my thesis does not consider the entire group of students in the same academic year or the same school as one community of practice. Even though, these communities of practice all regard the design studio learning environment as the core role for their constitution, wherever within or outside physical design studios.

Table 20 “Homogenous”, “Dispersive”, and “Intermodal” Community of Practice

Genre	Explanation	Characteristics
Homogenous	Students constitute larger-scale learning communities within the “homogenous” one. These communities offer the homogeneous learning environment where students have soft connections and competition to achieve better goals.	The “homogenous” community of practice is typically found in physical design studios, where all students consider themselves as a community aiming to achieve a common goal, such as grasping common architectural knowledge or skills.
Dispersive	Students constitute small-scale groups within the “dispersive” one. That sort of community of practice helps students keep a solid connection even though they are totally engaged in virtual environments.	The “dispersive” community of practice is more closely linked by a shared repertoire, and the tacit understanding among members is more pronounced. Within this community of practice, students typically constitute specific learning groups (typically containing 2-8 people) to cooperatively figure out tough issues, wherever within or outside physical design studios.
Intermodal	The mode of students’ informal learning between peers which are between homogenous and dispersive communities of practice. Students have no specific preferences on modes of informal learning between peers	“Intermodal” communities of practice act as the role of bridge to build the connection between “homogenous” and “intermodal” ones. Students of this community of practice sometimes engage in informal learning with their friends or study companions as the form of small-scale learning groups, and sometimes they engage in informal learning with a lot of people in the physical design studio as the form of a large-scale learning community.

CHAPTER NINE

Conclusions

9.1 Introduction

This thesis summarises the ways in which architecture students constitute their communities of practice by investigating their informal learning experiences between peers when they are outside formal timetable activities. Shreeve (2007) argued that, to constitute a successful community of practice in architecture education, mutual engagement between students and the studio tutor, as well as between students themselves, should be ensured primarily. Similar to the statement by Shreeve (2007), previous studies mainly emphasise the impacts of those engagements between students and the tutor on architectural education but overlook the ones between students themselves, especially outside the formal timetable activities, including sessions, tutorials, and desk crits (such as Shreeve 2007; Tunçer and Sariyildiz 2010; Morton 2012; Williams 2017; Piper 2017).

9.2 Response to the Research Question and Objectives

This thesis fills the gaps where there have not been obvious findings on the ways that architecture students' informal learning experiences between peers constitute the community of practice when those students are outside formal timetable activities. It was ultimately found that there are three main types of communities of practice constituted by architecture students, namely “Homogenous”, “Dispersive”, and “Intermodal” ones. These three types of “Community of Practice” answer the research question “What are architecture students’ modes of informal learning experiences between peers within the design studio outside formal timetable and characteristics of such modes, via the lens of the community of practice” in details, based on the characteristics of students’ informal learning experiences between peers.

Due to the pandemic and the introduction of virtual learning environments in architectural education, students’ informal learning between peers was also shifted online. This thesis takes this opportunity to make a comparison between those informal learning experiences

within the physical and virtual environments, respectively, to further address the first objective "to identify if the design studio learning environment impacts on architecture students' informal learning", the first phase of this study examines the self-assessments of architecture students from the Welsh School of Architecture, regarding their experiences with informal learning between peers in both physical design studios and virtual environments outside formal timetable activities, both before and during the COVID-19 pandemic. The findings of the first-phase study highlight the importance of the design studio in architecture education. This study successfully addresses the gaps in knowledge regarding the effectiveness of informal learning between peers when there is no pre-arranged planning of pedagogical modules. Specifically, the virtual environments were uncapable to encourage cooperative work and mutual assistance among students. It was also discovered that the virtual learning environments were highly involved in architectural education during the pandemic and even post-pandemic era, leading to more isolation among architecture students. Therefore, the virtual learning environment is still unable to replace the physical design studio in terms of some aspects of informal learning between peers. In conclusion, to foster informal learning between peers, the virtual environment should explore various alternative functions and measures to support, enhance, and potentially revolutionise the process.

To address the second objective "to classify these thematic modes of informal learning and to identify how what thematic characteristics that they have", this thesis subsequently conducts observations and interviews to investigate the informal learning experiences of more students from the Welsh School of Architecture outside formal timetable activities during the period when they just returned to school after the "work from home" policy. Through observations and interviews, the study participants expressed and elaborated their daily routines of informal learning experiences between peers outside their formal crits, sessions, courses, and tutorials. Consequently, the second-phase study identified three main modes of informal learning between peers of architecture students outside formal timetable activities, which are learning groups on a small scale, learning

communities on a large scale, and learning guerillas on no specific scales. Specifically, small-scale learning groups are typically composed of 2-8 people who are usually close friends or established study companions, and this learning mode can take place both within and outside the design studio; large-scale learning communities are typically composed of more than 8 people who usually engage in their own tasks and occasionally interact with others, and this learning mode usually occur within the design studio; no-specific-scale learning guerillas are organised by the students who have no preferences on informal learning modes, so they can engage in several learning groups and a learning community whatever they like. The findings also contribute to the design and construction of the physical environment in architectural institutions. Specifically, it provides references to the research field with suggestions to optimise the design studio learning environment. For example, the design of the design studio learning environment should enhance the face-to-face and distance contact between students, which means that there should be multiple types of spaces supporting physical interactions and blended learning activities. In addition, it should provide multiple spatial modes within the design studio for students to conduct both small-scale learning groups and large-scale learning communities to generate more possibilities for peer-to-peer engagements between students.

To address the third objective, "to identify the ways that communities of practice develop throughout different academic years", the second phase of study further classify modes and characteristics of students' informal learning experiences between peers via the lens of the community of practice, according to students' academic years. Specifically, it was found that first-year students typically do not have the habit of studying in the form of a learning group or community, so their design studio is rarely used outside formal timetable. Second-year students have established specific learning groups and communities, and many of them prefer learning in the form of several learning groups forming a learning community within their design studio. Third-year students usually tend to study in the form of small learning groups within the design studio and other places

outside their design studio, such as the tutorial space in the school building of the Welsh School of Architecture. In summary, all these forms are based on peer-to-peer engagements constructed by students themselves. Specifically, the students, who tend to study with specific friends and study companions, typically engage in the form of a learning group within the design studio or other specific spaces; while the ones, who tend to study in the design studio learning environment where a lot of people are present, typically engage in the form of a learning community within physical design studios.

To address the last objective "to generate a model of these thematic modes and to identify how the model can understand the establish of the using the theoretical lens of community of practice", this thesis introduced the concept of the community of practice into architectural education. Specifically, this study evaluates and classifies architecture students' informal learning experiences between peers according to the attributes of the community of practice, which are a shared repertoire, mutual engagement, and a joint enterprise. In addition, this study finds that these three attributes are supported by the characteristics of architecture students' informal learning experiences between peers and converted into the matrix of the variables determining specific community of practice (as shown in Figure 38).

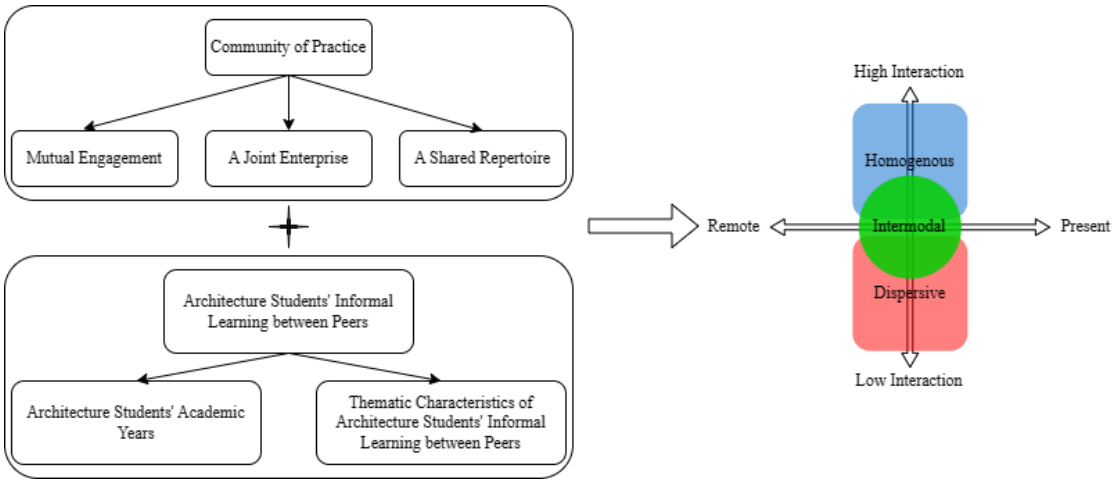

Figure 38 The Generation of This Thesis

9.3 Contribution to the Research Fields

This thesis offers practical implications for the research fields of the community of practice, architectural education, and architectural design studio. Specifically, the

findings summarise the relationships between architecture students' informal learning experiences between peers and three attributes of the community of practice, which are a shared repertoire, mutual engagement, and a joint enterprise; another contribution is to architectural education, analysing different modes and characteristics of the informal learning experiences between peers of architecture students outside formal timetable activities, to enable the studio tutors clearly understand what they could do to educate students in specific ways; the last but not the least main contribution is that this thesis can potentially provide references to the design and management of architectural design studios through architecture students' informal learning experiences between peers. The following contents will elaborate on the detailed implications of each research field.

9.3.1 Contribution to the Community of Practice

The first contribution of this thesis to the community of practice is that it highlighted three specific types of communities of practice, which are "homogenous", "dispersive", and "intermodal" communities of practice, respectively, according to modes of informal learning between peers outside formal timetable activities. Specifically, the "homogenous" community of practice indicates the learning community where multiple students are learning within the design studio, but they are engaging in their tasks and casually walking around to observe others' working processes; the "dispersive" community of practice means that a few students, who are usually close friends or have the same interests, learn in a small group outside the design studio; the "intermodal" community of practice acts as the bridge to connect these two communities of practice mentioned above, and community members can take part in both "homogenous" and "dispersive" communities of practice.

Moreover, my thesis explores the relationship between these communities of practice and the modes and characteristics of the informal learning between peers of architecture students outside formal timetable activities. Specifically, there are mainly three forms of such informal learning, which are learning groups on a small scale, learning communities on a large scale, and learning guerillas on no specific scales. Learning groups are usually

organised by close friends or established study companions, who have relatively strong but limited peer-to-peer engagements in their learning group. Typically, learning groups constitute dispersive communities of practice. In contrast, learning communities are typically organised by more than 8 individuals, who have relatively weak but various peer-to-peer engagements in their learning community. Learning communities usually constitute homogenous communities of practice.

The last contribution of this thesis to the community of practice is that it identifies that the ultimate acquisition of the community of practice is cultivating the appropriate knowledge, skills, values, and attitude to learn architecture. Although the required knowledge and skills differs for students in different academic years, the most common acquisitions are all design ideas and architectural technology; Besides, even though some students have unique characteristics that make them prefer learning individually, they still need to grasp the skills of cooperation and competition, which are required in their prospective career to some extent; Eventually, students develop different attitudes towards the discipline of architecture, such as passionate, fearful, exhausted, and lonely. After all, students in different learning stages have different feelings about architecture as well, depending on their basic capability and learning environment. For example, as freshmen, some 1st-year students begin to encounter the pedagogy of design and architecture, so they need to grasp basic knowledge of design from multiple sources, feeling curious and perplexed; Comparative, some others might possess talents in design-related knowledge, so they felt not so difficult to create a design work, feeling passionate and engaged. Furthermore, as the 2nd-year or junior students, they have learnt or been exposed to a large amount of knowledge, so they became more obviously polarised. Specifically, students who tend to engage in informal learning between friends and study companions typically have a relatively strong but limited peer-to-peer engagement within their learning groups; In contrast, others who tend to engage in informal learning within the studio learning environment have a relatively weak but various peer-to-peer

engagement to their learning community and acquire more motivations and inspiration compared within the learning group.

9.3.2 Contribution to the Architectural Education

The first contribution of this thesis to architectural education is that it conducted a specific investigation of architecture students' informal learning between peers outside formal timetable activities at the Welsh School of Architecture, Cardiff University. The study findings reveal the significance of the design studio learning environment in architectural education. For example, the study findings demonstrate that architecture students are more inclined to collaborate or interact with peers within the design studio learning environment of physical design studios. Consequently, virtual environments are relatively less effective in promoting cooperations and assistance-seeking between students. Many participants indicated that physical design studios provides them with the design studio learning environment characterised by physical context, students' learning and non-study related activities, and "sweating", which can inspire and motivate their own learning. However, most of them strongly asserted that maintaining these aspects in such environments is challenging. In addition, since the policy of "work from home" during the COVID, study participants all missed a whole year to get familiar with others. Thus, it is known from the investigation that the most obvious issue caused by working in isolation is that it makes students rely on themselves to confront difficulties and problems that could usually be easily resolved through face-to-face discussion. It demonstrates the irreplaceable peer-to-peer engagements in maintaining architectural informal learning between peers within physical environments, suggesting that the virtual environment for maintaining peer-to-peer engagements is still not mature. As a specialist in architecture pedagogy, such as self-organised tutorials, students need corresponding training to grasp the intuition and tacit knowledge. In contrast, there is yet to be a model or material for such training in virtual environments.

Subsequently, the second contribution is that this thesis employed ethnographical methods, including observations, interviews, and focus groups, to explore participants'

perceptions regarding their experiences of informal learning between peers outside formal timetable activities in detail. Specifically, there are mainly three modes of the informal learning experiences between peers of architecture students, classified as learning group on a small scale, learning communities on a large scale, and learning guerillas on no specific scales. Learning groups are typically organised by close friends or established study companions who usually contact with each other through either distance or face-to-face methods. They have limited "sweating" and contributions to constituting the "studio culture". The students who study in the form of learning groups believe that the space can be anywhere as long as the members of their learning group are present. Thus, learning groups are regarded as students' "comfort zone" in informal learning between peers, where students have relatively lower pressures from other group members. In contrast, learning communities are usually organised by more than 8 individuals engaged in their own tasks but occasionally walking around to review others' design processes. Members of learning communities typically contact with others through face-to-face contact methods often export "sweating" to others and contribute significantly to enrich the "studio culture". These students believe that the appropriate learning space for the learning community is undoubtedly the design studio. Therefore, learning communities are regarded as students' "challenge", where they need to overcome relatively higher pressures but acquire relatively more inspirations and motivations generated by the "studio culture" and "sweating" from others. Regarding the students who organise learning guerillas, they have no apparent preferences on informal learning modes, so they are typically willing to study in learning groups and a learning community whatever they like. These students also construct the connections between members of different learning groups and learning communities, enhancing the exchange of knowledge and skills.

The last but not least contribution is that the collected data reveal that architecture students have customary studio culture in different academic years. For example, many 1st-year students at the Welsh School of Architecture tended to seek help from their friends and study companions through social media even though there were no restrictions of

social distancing requirements. This was not only due to their initial unfamiliarity with each other but was also caused to some extent by the effects of the pandemic and the "work from home" policy. In contrast, many students who entered the 2nd academic year began to enjoy the learning atmosphere within their physical design studio and actively check others' working processes. Comparatively, most of the 3rd-year students organise informal learning experiences within their specific learning groups. Moreover, this thesis found that 2nd- and 3rd-year students have comparatively more senses of "sweating" within the design studio learning environment compared with 1st-year students. "Sweating" is a unique culture within the design studio learning environment especially within physical design studios, to effectively push students' design projects, but, in the meanwhile, generating pressures to some students. "Sweating" refers to an "invisible" competition between students, which was not specifically focus by previous researchers. The main reason may be that, compared with cooperation, the competition between students is more difficult to investigate as it is less "visible". It indicates that architecture students tend to have no direct competitions between each other. In other words, students compete with each other by presenting impressive design works, ideas, presentations, etc. to stimulate others' learning performances, just like the sweating within the gym.

9.3.3 Contribution to the Architectural Design Studio

The first contribution of this thesis to the architectural design studio is that it potentially offers suggestions for the future design of design studios. For instance, it was found that the virtual learning environment still cannot entirely substitute the design studio in terms of learning environments. To address these deficiencies, the virtual environment should explore certain alternative functions and measures to sustain, advance, and even innovate informal learning between peer students. Simultaneously, the design of a design studio learning environment should concurrently enhance the face-to-face and distance contacts between students. This implies that there should be various types of spaces that not only support physical interactions but also blended learning activities. In addition, the design studio should provide multiple spatial modes for students to conduct small-scale learning

groups and large-scale learning communities simultaneously, thereby further creating more possibilities for peer-to-peer engagements between students.

The second contribution is that it presents the measures for the future management of design studios. For example, the design studio is not a conventional educational space as it simultaneously provides architecture students with multiple functions but non-exclusive places. Therefore, the quantity of furniture and supportive facilities should at least be equivalent to the maximum number of all students. Additionally, the usage period of the design studio could be extended for several more hours instead of being restricted within a specific period a few days before the deadline. In this way, some students can gain more motivations to accelerate their efficiency in the form of a homogenous community of practice.

9.4 Research Limitation and Further Research

This thesis designs the matrix (as shown in Figure 37) for illustrating the relationships between different communities of practice and architecture students' informal learning experiences between peers, elaborating on three types, namely the "homogenous", "dispersive", and "intermodal" communities of practice constituted by such learning experiences. However, the characteristics of these three modes of communities of practice can also be extended, such as through quantitative methods to measure each learning individual for more specific research on such learning experiences. For example, the ways that students' individual preferences influence the joining of the specific communities of practice are expected to explore in further studies. Furthermore, it is also notable from the matrix that there are two other quadrants that may constitute the other two types of communities of practice. Specifically, the second quadrant implies that students' informal learning experiences highly depend on distance, remote, and virtual measures even though after the "work from home" policy; the fourth quadrant indicates that some students are enthusiastic about studying within the design studio learning environment but have almost no engagement with others who study in the same place. These two conditions are rarely found among architecture students, at least among the participants

in this thesis. Thus, future related research can expand the findings of the other two quadrants of each matrix to explore more details of these two types of communities of practice.

The second limitation of this thesis is that although this study evaluates the ways in which architecture students' learning experiences constitute the community of practice, it only focuses on students' informal learning experiences between peers. Prospective research should identify specific details of the potential effects of students' individual learning experiences on others, such as how someone's good reputation in a particular expertise inspires other students' passion for learning. Furthermore, it is necessary to determine the specific ways in which informal learning between peers affects the community of practice to provide further references for constitution and renovation of architectural design studios and even virtual learning environments. Therefore, the findings of this thesis offer further related research a reference for designing "learning architecture" in higher education, as indicated by Tummons (2014), especially regarding the dualities of reification and participation, and designed and emergent. Besides, the engagement of the community of practice in other disciplines of higher education should also be considered in future work.

In addition, this study targeted architecture students in only one specific British architectural institution, lacking generalisability. Thus, although this thesis provides the research field regarding the research method for collecting students' learning experiences, it still requires demonstration in future research investigating other schools throughout the UK and worldwide. Moreover, the samples are all undergraduate students, so the findings of informal learning experiences are limited to the undergraduate stage. Hence, future work can focus on experiences of postgraduate students.

Besides, this thesis is based on the context of the COVID-19 pandemic, so it is outside a typical period for investigating architecture learning experiences. Despite the physical learning model partially returning in the first half of the 2022, students' learning activities were still affected by the pandemic, at least during the investigation. Therefore, to make

a valid comparison between architecture students' informal learning experiences during pre-pandemic, pandemic, and post-pandemic periods, there is still much work to investigate the changes in the learning community after the COVID.

The last but not the least, my thesis found that some students are reluctant to engage in informal learning within the design studio learning environment due to the pressure caused by "sweating", and they complained that they have no feeling of belonging to this learning community. Thus, in addition to the three attributes of the community of practice pointed out by Wenger (1998), Li et al. (2009) argued that the concept of the community of practice was not developed, and it still needed some other characteristics to optimise it, including building a sense of belonging within the community of practice. Hall (2014) indicated that a sense of belonging is a basic need for any human being, and it means acceptance as a member in a group or community, so a sense of belonging to a great community of practice can improve members' motivation and avoid loneliness. Indeed, many previous identified that enhancing a sense of belonging can ensure a successful community of practice. For example, Huntwork et al. (2024) suggested that enhancing a sense of belonging can ensure the implement of a successful community of practice. In addition, Ribera et al. (2017) identified that some high-impact practices (Kuh 2013), such as learning community where students are encouraged to actively participate in learning activities, have positive effects on students' sense of belonging to their groups or institutions. As stated by Freeman et al. (2007), architecture students' sense of belonging can be enhanced by professional instructions from the studio tutor or other staff, while the ways in which the sense of belonging to the specific community of practice constituted by architecture students themselves was unclear. Likewise, as indicated by Krafona (2014), a good learning environment requires a vibrant community where members can feel a sense of belonging, to enhance members' cohesiveness and problem-solving abilities. Similarly, according to the investigation conducted by Gopalan et al. (2022) among US college students, the sense of belonging was negatively correlated with depression during COVID. In addition, Molloy (2021) emphasised that the physical

environment of the campus influences a student's experience of place at university, and a sense of place can affect a students' sense of well-being and belonging. However, my thesis has not further explored if the concept of the sense of belonging can enhance students' peer-to-peer engagements within a community of practice, so it can be a hypothesis in the future research. Thus, this thesis suggests that the concept of "sense of belonging" can be regarded as an additional characteristic of the community of practice in the further research. For instance, future researchers can investigate study participants' sense of belonging to their informal learning groups and communities, to identify if the sense of belonging can ensure a successful community of practice, or if it can be regarded as another attribute of the community of practice.

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APPENDICES

The Ethical Approval Form of the First-Phase Study

WELSH SCHOOL OF ARCHITECTURE
ETHICS APPROVAL FORM FOR STAFF AND PHD/MPHIL PROJECTS

Tick one box:	☐ STAFF ☒ PHD/MPHIL
Title of project:	A study on how successfully social relationships within physical design studios are enabled within the virtual environment for architectural education
Name of researcher(s):	Jierui Wang
Name of principal investigator	Andrew Roberts
Contact e-mail address:	WangJ127@cardiff.ac.uk
Date:	15/10/2020

Participants		YES	NO	N/A
Does the research involve participants from any of the following groups?	• Children (under 16 years of age)		×	
	• People with learning difficulties		×	
	• Patients (NHS approval is required)		×	
	• People in custody		×	
	• People engaged in illegal activities		×	
	• Vulnerable elderly people		×	
	• Any other vulnerable group not listed here		×	
• When working with children: I have read the University's Safeguarding Policy: https://intranet.cardiff.ac.uk/staff/policies				

Consent Procedure	YES	NO	N/A
• Will you describe the research process to participants in advance, so that they are informed about what to expect?	×		
• Will you tell participants that their participation is voluntary?	×		
• Will you tell participants that they may withdraw from the research at any time and for any reason?	×		
• Will you obtain valid consent from participants? (specify how consent will be obtained in Box A)[1]	×		
• Will you give participants the option of omitting questions they do not want to answer?	×		
• If the research is observational, will you ask participants for their consent to being observed?			×
• If the research involves photography or other audio-visual recording, will you ask participants for their consent to being photographed / recorded and for its use/publication?			×

Possible Harm to Participants	YES	NO	N/A
• Is there any realistic risk of any participants experiencing either physical or psychological distress or discomfort?		×	
• Is there any realistic risk of any participants experience a detriment to their interests as a result of participation?		×	

Data Protection		YES	NO	N/A
• Will any non-anonymous and/or personalised data be generated or stored?		×		
• If the research involves non-anonymous and/or personalised data, will you:	• gain written consent from the participants	×		
	• allow the participants the option of anonymity for all or part of the information they provide	×		

Health and Safety	YES
Does the research meet the requirements of the University's Health & Safety policies? (https://intranet.cardiff.ac.uk/staff/supporting-your-work/manage-your-office-or-lab/health-safety-and-environment)	×

Research Governance	YES	NO	N/A
Does your study include the use of a drug? You need to contact Research Governance before submission (resgov@cf.ac.uk)		×	
Does the study involve the collection or use of human tissue? You need to contact the Human Tissue Act team before submission (hta@cf.ac.uk)		×	

Prevent Duty	YES	
Has due regard be given to the 'Prevent duty', in particular to prevent anyone being drawn into terrorism? Cardiff University Prevent Policy https://intranet.cardiff.ac.uk/staff/policies	×	

If any of the shaded boxes have been ticked, you must explain in Box A how the ethical issues are addressed. If none of the boxes have been ticked, you must still provide the following information.
The list of ethical issues on this form is not exhaustive; if you are aware of any other ethical issues you need to make the SREC aware of them.

Box A **The Project** (provide all the information listed below in a separate attachment)

1. Title of Project
2. Purpose of the project and its academic rationale
3. Brief description of methods and measurements
4. Participants: recruitment methods, number, age, gender, exclusion/inclusion criteria
5. Consent and participation information arrangements - please attached consent forms if they are to be used
6. A clear and concise statement of the ethical considerations raised by the project and how is dealt with them
7. Estimated start date and duration of project

All information must be submitted along with this form to the School Research Ethics Committee for consideration

Researcher's declaration (tick as appropriate)	
• I consider this project to have **negligible ethical implications** (*can only be used if none of the grey areas of the checklist have been ticked*).	×
• I consider this project research to have **some ethical implications**.	
• I consider this project to have **significant ethical implications**	

Signature [signature] **Name** Jierui Wang **Date** 15/10/2020
Researcher or MPhil/PhD student

Signature [signature] **Name** Andrew Roberts **Date** 22/10/2020
Lead investigator or supervisor

Advice from the School Research Ethics Committee

It may be a good idea to make it explicit in your email that the participants responses will not be shared with their lecturers and will not have any impact on their grades.
This is less an ethical issue, but rather one to encourage them to participate.

STATEMENT OF ETHICAL APPROVAL

This project had been considered using agreed Departmental procedures and is now approved

Signature [signature] **Name** Dr Chris Whitman **Date** 20/10/20
Chair, School Research Ethics Committee

The Sample of the Interview in the First-Phase Study

Interview about learning and communicating environment within design studio

This is an interview aiming to find out the students' experience of learning in the design studio before and after the COVID-19 pandemic, to know students' thinking and evaluation to the changes of learning environment. This study is helping to design and construct more proper online and virtual design studio in this term and in case of the blended learning afterwards.

1. Studio learning experiences for learning since COVID-19 pandemic in March 2020

1.1 How do you undertake your design studio learning since the pandemic? And how do you think about it? Please narrate the experiences, changes, difficulties and the novelties you learned.

"Checklist" guide interviewees answer these questions: Does the studio help your architecture learning? How do you think working in the studio has helped your learning? What aspects of the studio is most use to you? And what do you value most? How important is the social side of learning in the studio? In what ways does the current learning experience help you for learning architecture? What else do you think need to be progressed/improved if you were to continue with this learning experience?

1.2 Could you please think about a specific project and talk about how the studio helped you to develop that project? How about group work and how the studio helps with this?

2. Activities within design studio

2.1 What activities do you typically undertake individually and/or collaboratively within design studio?

2.2 Have you been able to undertake these activities online since the pandemic? If do, how well have these translated into virtual activities?

The Ethical Approval Form of the Second-Phase Study

11/05/2022

Dear Jierui Wang

Research project title: The ways that architecture students constitute the community of practice

SREC reference: 2223

The Welsh School of Architecture's Research Ethics Committee ('Committee') reviewed the above application via its proportionate review process.

Ethical Opinion

The Committee gave

B a favourable ethical opinion of the above application on the basis described in the application form, protocol and supporting documentation, **subject to the conditions** specified below.

Conditions of the favourable opinion

The favourable opinion is subject to the following conditions being met prior to the start of the research project.

- Please use the attached amended PIS

Whilst the Committee does not propose to conduct a further review of your application/revised research project documents following implementation of the conditions above, you should notify the Committee once all conditions have been met and provide copies of any revised documentation with updated version numbers before the research commences.

Additional approvals

This letter provides an ethical opinion only. You must not start your research project until all appropriate approvals are in place.

Amendments

Any substantial amendments to documents previously reviewed by the Committee must be submitted to the Committee via ARCHI-ethics@cardiff.ac.uk for consideration and cannot be implemented until the Committee has confirmed it is satisfied with the proposed amendments.

You are permitted to implement non-substantial amendments to the documents previously reviewed by the Committee but you must provide a copy of any updated documents to the Committee via ARCHI-ethics@cardiff.ac.uk for its records.

Monitoring requirements

The Committee must be informed of any unexpected ethical issues or unexpected adverse events that arise during the research project.

The Committee must be informed when your research project has ended. This notification should be made to ARCHI-ethics@cardiff.ac.uk within three months of research project

[Version 00] [Date 11/05/2022]

completion. For Student projects, submission of the associated dissertation will be considered to be notification.

Documents reviewed by Committee

The documents reviewed by the Committee were:

Document	Version	Date
WSA_Ethics_Project_Information_Sheet_2021.doc	2	05/05/2022
WSA_Ethics-Consent-Form_2021.doc	1	
WSA_Ethics-Review-Application-Proforma_2022_Signed_AR.doc	2	05/05/2022

Complaints/Appeals

If you are dissatisfied with the decision made by the Committee, please contact the Chair of the Committee via ARCHI-ethics@cardiff.ac.uk in the first instance to discuss your complaint. If this discussion does not resolve the issue, you are entitled to refer the matter to the Head of School for further consideration. The Head of School may refer the matter to the University Open Research Integrity and Ethics Committee (ORIEC), where this is appropriate. Please be advised that ORIEC will not normally interfere with a decision of the Committee and is concerned only with the general principles of natural justice, reasonableness and fairness of the decision.

Please use the Committee reference number on all future correspondence.

The Committee reminds you that it is your responsibility to conduct your research project to the highest ethical standards and to keep all ethical issues arising from your research project under regular review.

You are expected to comply with Cardiff University's policies, procedures and guidance at all times, including, but not limited to, its Policy on the Ethical Conduct of Research involving Human Participants, Human Material or Human Data and our Research Integrity and Governance Code of Practice.

Yours sincerely,

Dr Chris Whitman

Senior Lecturer
School Ethics Officer and Research Integrity Lead
Welsh School of Architecture
Cardiff University
Bute Building
King Edward VII Avenue
Cardiff CF10 3NB
Wales U.K.
Tel: +44 (0)29 2087 5893
Email: WhitmanCJ@Cardiff.ac.uk

Uwch Ddarlithydd
Swyddog Moeseg yr Ysgol ac Arweinydd Gonestrwydd Ymchwil
Ysgol Pensaernïaeth Cymru
Prifysgol Caerdydd
Adeilad Bute
Rhodfa'r Brenin Edward VII
Caerdydd CF10 3NB
Cymru D.U.
Ffôn : +44 (0)29 2087 5893
E-bost: WhitmanCJ@Cardiff.ac.uk

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