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# Architecture students' peer learning in informal situations by lens of the community of practice – one case study

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**ABSTRACT**

This paper discovers peer learning environments by the lens of the community of practice, investigating architecture students' peer learning experiences in informal situations when they are outside formal timetable activities in the Welsh School of Architecture (WSA), Cardiff University. This paper associated undergraduate architecture students who experienced virtual learning and physical learning during and after the pandemic, to compare the ways that those students constitute the community of practice within both physical and virtual environments. Taking observations, interviews, and focus groups, those students' peer learning experiences provided a whole view of the thematic characteristics that they constitute communities of practice in different learning environments. Those findings are consistent with previous studies conducted with architecture students but also extended that research by specifying the relationship between peer learning in informal situations and the community of practice within two different contexts. Two main categories of communities of practice, which are homogenous and dispersive ones according to such thematic characteristics, were found in this study.

## 1. Introduction

### 1.1. Importance of peer-to-peer learning in architectural education

Since the end of the twentieth century, higher education has focused its purpose on prompting students to be active learners whose communication, collaboration, and knowledge construction are key learning abilities (Marshalsey & Sclater, 2020). Higher educational institutions are currently making efforts to build a learning community that can facilitate learning, teaching, group work, presentations and assessments by means of digital or virtual portals (Marshalsey & Sclater, 2020). Thus, educational spaces are required to accommodate specific devices and facilities allowing flexibility and optimal support for the learners and their learning environment (Johnson, 2018, p. xi). Since the studies of Schön during the 1980s, the teaching and learning activities for the design studio are classified into the design brief, desk crit, design review, drawing, making models, sharing ideas with peers and tutors, working with people around, etc. (Johnson, 2000; Schön, 1987; Webster, 2008). To the uniqueness of architectural pedagogy, students are required to be engaged in multiple participative processes involving interaction with other individuals in the design studio (Nicol & Pilling, 2000). For example, Schön (1983) proposed the "reflective practice", which identified that active learning, social interactions and engagement (Lee, 2006) play a

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premium role in this process (Kvan, 2001; Nicol & Macfarlane-Dick, 2006). The learning theory supports students to benchmark themselves against peers in the form of the "community of practice" (Koch et al., 2002).

## 1.2. Potential of "community of practice" as a lens to the research field

This paper regards the design studio as a "community of practice". Regarding the community of practice, Wenger et al. (2002, p. 4) 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. This is to say, to foster the community, students are encouraged to learn from peers (Zamberlan & Wilson, 2015) collectively and actively to a stated goal (Adam et al., 2011). Thus, a community of practice enters into the experience of participants through their very engagement, resulting in four basic characteristics: mutual engagement, a joint enterprise, and a shared repertoire (Wenger, 1998b, p. 73). Accordingly, to constitute a successful community of practice, different core roles within the community of practice should be performed well by students, including community leaders, facilitators, subject-matter experts, core members, and "lurkers" (Baker & Beams, 2016).

Engaged in architecture, communities of practice have brought some practical contributions. For example, Williams (2017) articulated that the design studio environment has the capacity to bring students with shared meanings, goals and responsibilities, and the self-organised community of practice encourages individual student's learning. Besides, Morton (2012) indicated that, even outside of class, students usually involve in informal groupings based on country of origin and friendships, to develop their learning process. It was also found that architecture students normally self-organised learning groups to study more knowledge beyond the tutorials and desk crits (Morton, 2012; Williams, 2017).

Therefore, by engaging in the concept of the "Community of Practice", the main research question "How does students' peer learning constitute the community of practice outside formal timetabled activities?" needs to be answered.

## 2. Literature review

### 2.1. Peer learning in informal situations and the community of practice

A community of practice enters into the experience of participants through participants' very engagement, resulting in the three essential characteristics: mutual engagement, a joint enterprise, and a shared repertoire (Wenger, 1998b, p. 73). Mutual engagement refers to engaged diversity, doing things together, relationships, social complexity, community, and maintenance. A joint enterprise results from a collective negotiation process that reflects the full complexity of mutual engagement, including negotiated enterprise, mutual accountability, interpretation, rhythms, and local response. A shared repertoire contains stories, artefacts, styles, tools, actions, historical events, discourses, concepts, etc. (Wenger, 1998b, pp. 73–85). Wenger (1998a) 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 can increase the learning potential of that community (Wenger et al., 2002). Therefore, when we describe some learning activities as the community of practice, we also need to define those activities' specific details of mutual engagement, a joint enterprise, and a shared repertoire of the community of practice, so that we can state satisfactorily what the practice of the community actually is (Tummons, 2014, p. 135).

While without 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 peer learning in informal situations.

## 2.2. Relationship between the design studio education and the community of practice

Community of practice theory has been introduced into architectural education since the informal learning model is becoming more popular, to encourage students' peer collaboration outside the formal timetable. Many previous authors introduced a student-centred learning model to bring more energy and passion to students' active learning without studio tutors' instructions and hierarchies.

For example, it is recognised that the expectation of high performance of students' learning practices requires the cooperation between professional instructions and a strong community of practice framework (Zamberlan & Wilson, 2015). The graphical relationship between the community of practice in design-related disciplines and four characteristics is illustrated in Figure 1.

To achieve a successful community of practice, it is vital that the studio instructor and students ought to act in appropriate core roles (Baker & Beams, 2016). Thus, except 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 vital that some individuals act as core members and lurkers to associate informal meetings and gain value from the community of practice peripherally. 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 (Baker & Beams, 2016). However, Williams (2017) indicated that the usefulness of a strict application of a community of practice model is questioned as it is hard 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 being determined if this form of community of practice keeps the same since students learn outside formal timetable activities, which means that students get 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
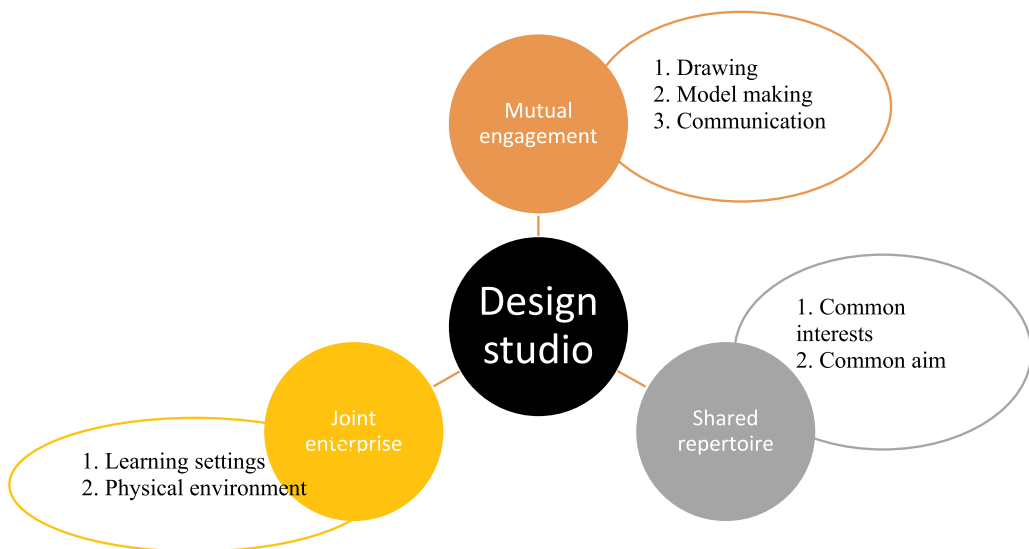


**Figure 1.** Community of practice in design-related disciplines.

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. The material practising dimension is conditional upon having the suitable materials, equipment, spaces and the freedom to make a mess (Williams, 2017). However, Morton (2012) articulated that participation in the environment of the studio did not follow a discrete community of practice model, because many students seek and find a form of legitimate peripheral participation outside of 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 if and how the community of practice extended beyond these and how and if 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 the design studio. However, the 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 in encouraging 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 relative studies above, there have been many findings of contributions of students' active learning within the design studio. Even though introduced the theory of the community of practice, the researchers mainly focused on students' interactions between tutors and themselves within the formal pedagogies. In contrast, there have been no apparent findings of architecture students' interactive peer learning in informal situations and outside formal timetable activities, let alone the ways that the community of practice helps students get architectural design knowledge and skills.

## 3. Methodology

### 3.1. Introduction

Much of the vital work that has contributed fundamentally to ourselves and our understanding of the society has been based on qualitative studies (Weiss, 1994, pp. 9–11). Mohajan (2018) cited that qualitative research is inductive in nature, and the researcher generally explores meanings and insights in a given situation (Levitt et al., 2017; Strauss & Corbin, 2008). It refers to a range of data collection and analysis techniques that use purposive sampling and semi-structured, open-ended interviews (Dudwick et al., 2006; Gopaldas, 2016). In this study, the expedient way to know how students' learning experiences outside formal timetable activities is by recording some candidates' narratives of their learning experiences, known as narrative inquiry (Chase, 2013, p. 56).

In line with some former research examples, researchers also applied qualitative research methods to collect volunteered research participants', including students and project staff, experiences and perceptions on the projects or courses, which were 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 & Sclater, 2020).

### 3.2. Study participants

As for the participants of this paper, the data originated from undergraduate architecture students in different academic years, representing various educational levels, and only volunteered students

**Table 1.** 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.<br>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.<br>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. |

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 paper, 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 1 illustrates the reasons for selecting students ranging from 1st- to 3rd-year students as samples.

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

**Table 2.** Basic information of interviewees in the second-phase study.

| Identity | Gender | Duration | Home/International student |
|---|---|---|---|
| 1st-year interviewees | | | |
| Student A-Year 1 | Female | 25 min | International Student |
| Student B-Year 1 | Male | 18 min | International Student |
| Student C-Year 1 | Female | 18 min | International Student |
| Student E-Year 1 | Male | 21 min | Home Student |
| 2nd-year interviewees | | | |
| Student A-Year 2 | Male | 15 min | Home Student |
| Student C-Year 2 | Male | 17 min | Home Student |
| Student D-Year 2 | Male | 22 min | International Student |
| Student E-Year 2 | Female | 20 min | International Student |
| Student F-Year 2 | Female | 18 min | Home Student |
| Student G-Year 2 | Female | 30 min | International Student |
| Student H-Year 2 | Male | 24 min | Home Student |
| Student J-Year 2 | Female | 14 min | Home Student |
| Student K-Year 2 | Female | 13 min | Home Student |
| Student L-Year 2 | Female | 12 min | Home Student |
| 3rd-year interviewees | | | |
| Student A-Year 3 | Female | 36 min | International Student |
| Student B-Year 3 | Male | 15 min | Home Student |
| Student C-Year 3 | Female | 21 min | Home Student |
| Student D-Year 3 | Male | 23 min | International Student |
| Student E-Year 3 | Female | 17 min | International Student |
| Student F-Year 3 | Male | 24 min | International Student |
| Student G-Year 3 | Female | 22 min | Home Student |
| Student H-Year 3 | Male | 18 min | Home Student |
| Student J-Year 3 | Female | 16 min | Home Student |
| Student K-Year 3 | Male | 23 min | Home Student |
| Student M-Year 3 | Female | 14 min | Home Student |

### 3.3. Data collection

### 3.3.1. Observation

One way to capture students' peer learning experiences in informal situations is by observing the peer learning activities of some volunteers, as some previous research shows that observation can find out students' learning experiences more straightforwardly and clearly (Shaffer, 2003; Rodriguez et al., 2018). In this paper, semi-structured observation was applied as it is the research seeking to identify practical problems individuals experienced (Gillham, 2008, p. 19). Hence, during the process, students' peer learning experiences were observed and assisted with asking them some open-ended questions if unpredicted issues happened. Since this approach is an ongoing process, collecting these first reflections can be valuable in guiding and providing suggestions for analyses of other data collection methods (Phillippi & Lauderdale, 2018).

To record students' specific experiences, Gillham (2008, p. 23) indicated that the primary observation measure is watching them during their everyday lives, assisted with taking field notes of students' peer learning activities (Shaffer, 2003). Hence, the whole process was recorded by field notes to review and compare each observation further to make critical analyses (Gillham, 2008, p. 27). Within those notes, the investigator could check the items that target students were experiencing and add references to mark the uncertainties and specificities. Besides, there were some unexpected and peripheral conditions or scenarios that the investigator could not recognise, so some participants were asked to answer some structured and semi-structured questions to clarify during and after the observation (Frankfort-Nachmias & Nachmias, 2008, p. 189), but ensuring that their normal behaviours were not influenced (e.g. wearing headphones to listen to music). The specific questions, which should be asked during/after the observation, are depended on the peer learning activities that students did in informal situations outside formal sessions, tutorials, and desk crits. Thus, the questions may be changeable during the observation. The common questions include:

1. I noticed that you often communicate and cooperate with your fellows in (this or that) way(s). Could you explain the reasons for the specific activities? What else do you usually do to interact with your course mates?
2. What have you learned since the interactions with your fellows that formal sessions, tutorials, and desk crits did not teach?
3. How do you think that those interactions help your architectural learning or develop your design projects?

In summary, till the end of this study, there have been twenty observations, including three for 1st-year students (two within their year studio and one within a tutorial space), six for 2nd-year ones (three within their year studio, two within tutorial spaces, and one remotely), ten for 3rd-year ones (five within their year studio, three within tutorial spaces, and two within their accommodations), and one for 5th-year ones within their year studio.

### 3.3.2. Interview

To get clear of some students' underlying activities during observations, some of them were invited to take individual interviews to supplement the data collected from the observation. The multi-measures can also find some points that the participants did not mention, to facilitate a better understanding of students' peer interactions (Kawulich, 2005). According to unknown aspects of students' peer learning experiences from observations, the semi-structured and open-ended questions were categorised into three themes. The first theme is collecting prevalent students' peer learning in informal situation activities within the design studio. The second theme is getting to compare students' peer learning in informal situations within diverse learning environments (design studio and other places). The last one is asking for students' perceptions on their peer learning in informal situations

within different learning environments. The specific questions of the first theme are articulated below:

1. Do you usually study with your fellows within the design studio outside formal desk crits, sessions, and tutorials?
2. 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).

The question of the second theme is:

3. Does the learning environment within the design studio facilitate those learning processes?
4. What are the differences between doing them within and outside the design studio (such as learning culture, learning environment, living cost, commuting time, etc.)?

The question of the third theme is:

5. How do those learning processes help your architecture learning?

In summary, till the end of this study, there have been thirty-seven individual interviews, containing ten 1st-year students (five within the 1st-year design studio, one within the student accommodation, two remotely), twelve 2nd-year students (nine within the studio and three remotely), thirteen 3rd-year students (eight within their 3rd-year studio, three within the tutorial space, and two remotely), two 5th-year student (one within the 5th-year studio, another remotely), and two Year Chairs.

### 3.3.3. Focus group
Individuals only reporting their behaviours verbally, however, may not validly capture peer learning activities in informal situations (Frankfort-Nachmias & Nachmias, 2008, p. 189), as they request subjects to post-rationalise their experiences rather than capture subjects in action. Particularly in architecture, a practice-based discipline, students' learning activities are sourced from their intuition and tacit knowledge (Kampen, 2019), so they may have no sense of happened learning experiences. 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).

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 (Gillham, 2005, p. 60). This study describes the topic as "experiences of peer learning in informal situations", and the individuals are defined as "students who study together in the same design studio or other places". The most important is that the participants of each focus group can be regarded as a community of practice (Reasoner, 2017), so that it is easy to compare with the learning patterns of each community of practice.

In summary, till the end of this study, there have been nine focus groups, consisted of four 1st-year students in their design studio, three 2nd-year students within the tutorial space, five 2nd-year students within their design studio, two 2nd-year students at outdoor spaces, three 2nd-year students within their design studio, two 2nd-year students within the design studio, three 3rd-year students within their design studio, two 3rd-year students within a cafeteria at Main Building, and four 3rd-year students within their design studio.

### 3.4. Data analysis

To interpret field notes of observations to valuable data, this study applies the "thick description" (Geertz, 1973). Specifically, students' learning activities and experiences were structured by different genres of the phenomenon and coded into different symbols. The reason to digitalise

**Table 3.** Structure of observation field notes.

| 1st cluster | 2nd cluster | Code |
|---|---|---|
| Design Studio / Space outside the Design Studio / Remotely | Help each other or being helped, compare work, working together | 1.1/2.1/3.1 |
| | Be motivated by being in the studio, such as to work harder | 1.2/2.2/3.2 |
| | Socialising, just like talking about things not directly related to the project and studio environment, etc. | 1.3/2.3/3.3 |

the field notes is that they can be searched by keywords and recognised by topic, time, or partici-pants (Phillippi & Lauderdale, 2018). Different learning spaces were coded as the first cluster, indicat-ing 1, 2, and 3; Different learning activities were clustered into the second level, indicating 1.1, 2.1, 3.1, etc. Afterward, peer learning activities are determined by the observations' contents, and the specific structure of the thick description is illustrated in Table 3 as shown below:

To analyse transcripts from interviews and focus groups, the thematic analysis was selected as the data analysis technique to identify general opinions into specifically organised themes and further model coding framework (Barbour, 2007, p. 123). This paper ultimately applied the procedure of the thematic analysis pointed out by Braun and Clarke (2006), divided into "setting high-level themes" "familiarising with the data", "generating intimal codes", "searching for themes", "review-ing themes", and "defining and naming themes". Different from perspective of Braun and Clarke (2006), this paper initially added a step to ensure that all data are sourced from the attributes of the community of practice. The steps of the thematic analysis are described in Table 4.

Specifically, in light of transcripts interpreted from focus groups and interviews, students' peer learning activities outside formal sessions, tutorials, and desk crits were coded into specific themes. Table 5 illustrates the thematic structure of the themes.

### 3.5. Ethical aspects

The conduction of observations, interviews, and focus groups all follow the ethics policies of Cardiff University, and the Ethics Approval Form is attached in the Appendix.

## 4. Results

### 4.1. Mutual engagement supported by face-to-face and distance contacts

This section focuses on students' engagements outside the formal timetable, providing the views and stories of some sample architecture students' mutual engagement when engaged in

**Table 4.** Process of the thematic analysis in this paper.

| Phase | Description of the process | What actually did in this paper |
|---|---|---|
| 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 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 |

**Table 5.** Themes of interviews and focus groups.

| Themes | Face-to-face and distance contacts | Studio environment | Peer-to-peer bonds |
|---|---|---|---|
| Specific indication | Students' interactions, such as communications, cooperation, competitions, and helping and getting help from others. | Regarding the design studio, the physical settings and things that happened amongst students within it. | As for what happens between students, they are mostly based on students' common interests, traits, concerns, values, aims, etc. |

different learning environments, summarising the general characteristics and attributes of such engagement.

### 4.1.1. Face-to-face contact within physical learning environments

This paper finds that many students engage in peer learning with others by face-to-face contact methods within physical learning environments, whatever the design studio or other non-timetabled spaces outside the design studio. There are typically three types of students' selections on learning spaces.

1. The first type refers to the ones who like learning in the design studio. The observation in Table 6 illustrates a typical scene of architecture students' peer learning within the design studio outside formal timetable activities. Within the example, it seems that students engaged in peer learning within the design studio are that the learning environment can bring them motivations and passion. In addition, some interviewees' accounts in Table 6 depict that learning within the design studio can save their living costs.
2. The second type is the ones who like learning outside the design studio. There are two main reasons for this learning mode. The first reason is that they dislike the studio environment where there are other students and stuff distracting them. The second one is the external elements influencing them, such as commute time from their home to school and weather conditions, as shown by some interviewees' accounts in Table 7.
3. Besides, it was also noticeable from some students that the selection of learning spaces has specific conditions, such as the stage of design projects and the physical environment within the learning space. For example, some interviewees' accounts in Table 8 illustrate some conditions of selecting learning spaces. Some students regard well-established facilities as important elements to their own learning. Some ones regard getting supports from others face-to-face as the significant elements to their personal acquisition.

### 4.1.2. Distance contacts outside physical learning environments

Despite the fact that it can bring benefits to architecture students that they study by means of face-to-face within physical spaces, it does not mean that students' mutual engagement can only be kept

**Table 6.** Examples of students who like peer learning within the design studio.

| Data sources | No. | Contents |
|---|---|---|
| Observation | Field Notes 1.1 (20th April 2022) | Many students are studying within the design studio, looking for help from or having casual chats with others within the studio environment where students are around … there is no other specific aim for them to study within the environment where people are around, but they are convinced that it literally brings them the motivation and passion for doing their own design tasks. |
| Interview | Student C-Year 3 | Some of my friends faced difficulties to dealing with the increasing electricity and gas bills … so they have a better choice to study within our design studio |
| | 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 |
| | Student K-Year 3 | Yeah, the electricity bill increased dramatically monthly … Otherwise, I will spend the whole day in my design studio to save the cost in the coming winter |

**Table 7.** Example of students who like peer learning outside the design studio.

| Data sources | No. | Contents |
|---|---|---|
| Observation | Field Notes 2.2 (30th March 2022) | A great ratio of students study in their own rooms or a unit in the tutorial space, and they only do the work with peers when they are running for the AT assignment and group meeting. |
| Interview | 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 |
| | Student C-Year 3 | I normally study at home, as I want to save time on dressing up and commuting. |
| | 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. |

by this method. For example, some students, who prefer learning in isolation at home, got used to communicating or asking for help via social media and other relative applications, such as Zooms, What's App, and WeChat, whenever during or after the pandemic. Some interviewees' accounts in Table 9 illustrate their experiences of distance contact methods.

Nevertheless, even though some learning activities can be conducted via distance contact methods, some activities are still not available via these methods. For example, as shown in Table 10, some interviewees indicated that sharing physical learning materials face-to-face, comparing the design progress, and the studio environment where students are encouraged, were all disabled when they were learning in virtual learning environments.

Accordingly, the mutual engagement between architecture students is somewhat different when they have face-to-face contacts and distance contacts. Table 11 illustrates some typical mutual engagements between architecture students, and they all reveal that they were literally influenced by the learning in isolation within their own home, such as low efficiency of material sharing and group model making. Therefore, face-to-face contacts between students maintain some basic peer-to-peer activities which could inspire or even determine their architectural thinking and design projects.

## 4.2. Joint enterprise is maintained by the studio environment

This section regards the design studio and the things happened within it as the environment where students can constitute their various specific communities of practice, and the studio environment refers to the place in which a joint enterprise occurs.

**Table 8.** Examples of students select learning spaces in different conditions.

| Data sources | No. | Contents |
|---|---|---|
| Interview | Student G-Year 3 | I prefer the environment and the well-established facilities within my own room. Even though, I admit that sometimes I still need help from my fellows, so I come to the design studio as well but close to the deadline, just like today. |
| | Student D-Year 3 | 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 E-Year 3 | Now I prefer learning with the design studio 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 E-Year 1 | … knowledge of architectural technology can only be acquired from the tutor's slides and the sample works done by (other) students. That's why we generally do the technological assignment altogether because we can share materials efficiently and ask for help from others within the studio. |
| Focus Group | Student B-Year 3/ Student D-Year 3 | We two used to study within the public space of our student accommodation … , but … it was not pretty pushing (for the) project. |
| | | The public space in the accommodation is too loud to study, so we studied at the tutorial space when it was close to the deadline. That place is relatively quiet … but it is still not available to study when there are tutorials within the space. |

**Table 9.** Some typical distance contact methods of peer learning between students.

| Data sources | No. | Contents |
|---|---|---|
| Interview | 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 … It was so grateful that there were distance communication applications during that period. |
| | Student G-Year 2 | … my friends and I study within our own rooms to avoid the bad weather … Just in case we do not know other's design process, we communicate with each other on What's App and check the Miro. |
| | 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. |

**Table 10.** Learning activities that cannot conducted in virtual learning environments.

| Data sources | No. | Contents |
|---|---|---|
| Interview | 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 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. |
| | 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. |

**Table 11.** Comparison of mutual engagement by face-to-face and distance contacts.

| Different engagements | Face-to-face contacts | Distance contacts | 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. |
| Initial Stage of Design | 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 make the initial design based on the findings from site visits and discussions between site visitors, 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 studio 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 whole 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. |

**Table 12.** Examples of students enjoying learning within the physical studio environment.

| Data sources | No. | Contents |
|---|---|---|
| Interview | 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. |
| | Student K-Year 2 | We can see others' working products and progress when we are all studying in the studio. |
| | 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. |
| | Student H-Year 3 | It's helpful to receive suggestions on my design project from others learning within our studio. |

### 4.2.1. Studio environment within physical and virtual environments

Different from the environment in the traditional classroom environment where only existing teaching, the studio environment is a context where different individuals are available to express their experiences and abilities, whatever they have and want, anywhere and anytime. Hence, the studio environment is theoretically available in whatever physical or virtual environments.

1. For some students, connection through the studio environment was a fluid process that took place over the course of a day or week. It was found that most students rely on the studio environment where different people are around, to ask their peers and friends whenever and wherever, to get inspiration and motivation through face-to-face communication. Thus, the design studio environment can be deemed a joint enterprise where architecture students organise peer learning as a form of the community of practice. For example, some interviewees' accounts in Table 12 illustrate some benefits of peer learning within the studio environment.
2. For others, it was a ritualised process of discrete visits made solely to keep a peripheral connection with the studio environment, and one that had to be reconciled with the need to get on with work elsewhere. Hence, the virtual context weakens the studio environment. To solve the issue, as illustrated in Table 13, some students found alternative ways to constitute a similar studio environment within the virtual environment, to keep them on track with the whole design process and learn from others' ideas and thinking.

### 4.2.2. Architecture students' "sweating" matter the studio environment

This paper revealed a unique culture usually occurs within the studio environment in informal situations, indicating the "sweating". Specifically, "sweating" is an informal term design 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 hardworking in the gym. It indicates that students compete with others by presenting impressive design works, ideas, presentations, etc. to stimulate others' performances.

**Table 13.** Examples of students creating the studio environment in virtual environments.

| Data sources | No. | Contents |
|---|---|---|
| Interview | Student A-Year 3 | Online meeting applications, such as Microsoft Teams and Zoom, kept (an) alike studio environment. |
| | Student D-Year2 | 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 K-Year 3 | 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. I just uploaded 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 at home. Some of our group members were at the tutorial space … so we used the screens within the tutorial space and our laptops to have a hybrid talking. |
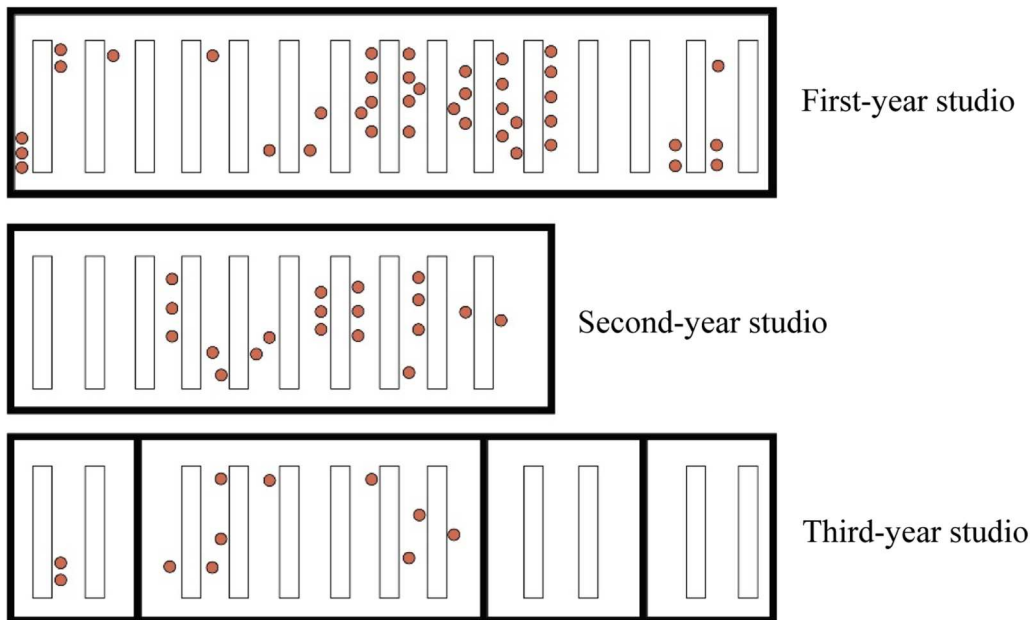
**Figure 2.** Distribution of students in three design studios before the deadline.

For instance, Figure 2 illustrates the distribution of students in 1st-, 2nd-, and 3rd-year studios, respectively, at 3 pm on 28th April 2022. Subsequently, Figure 3 presents the distribution of students in all three academic years after year one students submitting the final work of AT1. There were two specific observations regarding these two scenes as shown in Table 14.

It can be revealed from observations above that "sweating" refers to an unconscious competition between architecture students only when they have a view of others' work process. In other words, some students regard "sweating" as their pressure to study architecture. To prevent themselves from "sweating", those students normally study individually in their own room or with some close friends in other public spaces, such as the learning space within their student accommodation (Table 15).

It can be found from Figure 2 and Figure 3 that even though the occupation rate of the first-year studio changes a lot before and after the deadline, the rate of the second- and third-year studio did not change dramatically. Comparatively, there is nearly no sense of "sweating" found among first-year students, since the occupation rate changed dramatically in the Year 1 design studio before and after the deadline for AT assignment of the first academic year. The reason for that phenomenon was mainly because of the motivation brought by dramatic "sweating" within the physical design studio, as indicated by some interviewees in Table 16. To unfold these reasons, the contents in the next sub-section will elaborate on the personal characteristics of some interviewees from year 1 to year 3, and it will explain the rationale that 1st-year students have no sense of "sweating" within the design studio.

It is also noticeable that "sweating" is typically pronounced in the physical design studio rather than other spaces, especially virtual environments, since it is generated from the environment where many people are present. As indicated by some interviews in Table 17, they had the feeling of "sweating" only in their design studio.

### 4.3. Shared repertoire is constituted by peer-to-peer bonds

In this paper, a shared repertoire regarding architecture students means the common language, cultural basis, interests, habitus, and jargon within a specific peer learning group or a peer learning
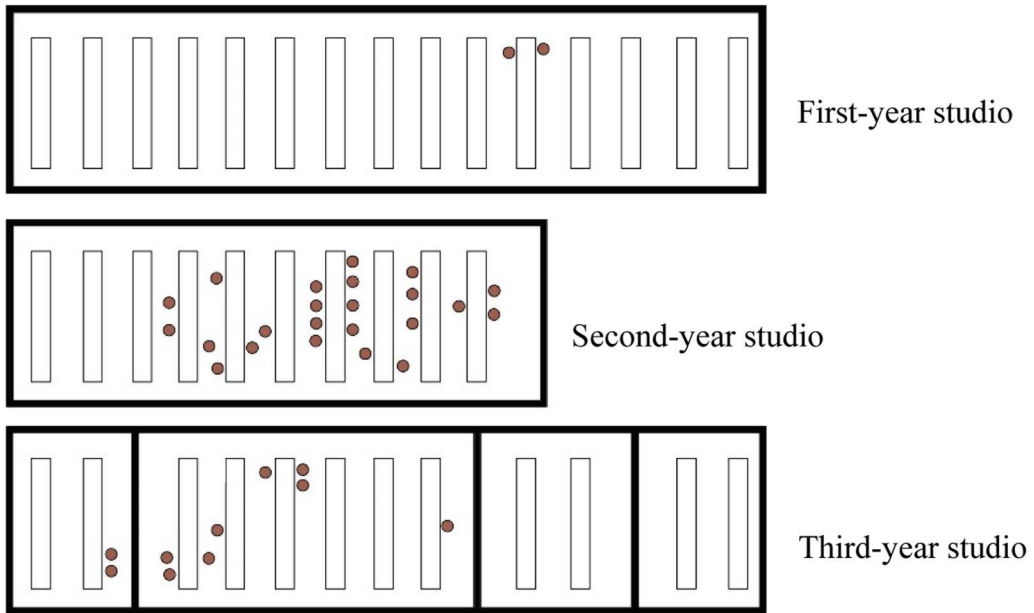
**Figure 3.** Distribution of students in three design studios after the deadline.

community. This section focuses on architecture students' peer-to-peer learning experiences outside formal timetable activities, which means their learning experiences are without the power of studio tutors and programmes. It is found that peer-to-peer bonds are generally generated by students with common interests, cultural basis, and habitus, facilitating students' personal learning skills to some extent. Those common characteristics belong to a shared repertoire in the view of this paper.

### 4.3.1. Architecture students' peer-to-peer bonds in physical and virtual environments

This paper found that architecture students constitute a shared repertoire which is supported by peer-to-peer bonds between close friends or a mutual learning community.

1. Specifically, peer-to-peer bonds between students are based on mutual interests, values, and learning and/or living experiences deems a shared repertoire. As illustrated in Table 18, students from two focus groups all agreed that they engaged in peer learning due to the common race and interests.
2. In addition, some other students indicated that their peer-to-peer bonds were created by daily social activities whatever organised by the school or students themselves, as illustrated in Table 19.
3. However, this paper found that most architecture students lack opportunities to build peer-to-peer bonds outside formal timetable activities, especially within virtual learning environments. Consequently, without closed and stable peer-to-peer bonds generated from offline learning, a considerable of students lost their focus on cultivating their interests and ambitions of architecture learning when they were learning online. The main challenge is facilitating social structure and networking. Thus, to constitute a successful community of practice in virtual learning environments, the connections between students are required to be reinforced. Nevertheless, a few students still felt that learning in virtual environments does not matter a lot on maintaining their peer-to-peer bonds. For example, Table 20 depicts that some interviewees indicated some measures to maintain peer-to-peer bonds within virtual environments.

**Table 14.** Different scenes before and after the deadline of submitting the architectural technology assignment.

| Data sources | No. | Contents |
|---|---|---|
| Observation | Filed Notes 1.3-1 (3rd Nov 2022) | 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). 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. |
| | Field Notes 1.3-2 (8th Nov 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. |

**Table 15.** Examples of students regarding "sweating" as pressures.

| Data sources | No. | Contents |
|---|---|---|
| Interview | Student B-Year 3 | He was so "sweating" … he even did not sleep last night with his weak body to finish some critical parts in the AT? … 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 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. |
| | Student K-Year 3 | My friends always say that I am so "sweating", but I think they are more "sweating" than me … it's just an attitude to show that they would be "sweating" as well. |

### 4.3.2. Architecture students' peer-to-peer bonds in different scales of peer learning

As for specific shared repertoire, it is also determined by different scales of peer learning. Specifically, there are usually two main categories of self-organised peer learning scales, divided into large-scale learning communities and small-scale learning groups, as illustrated in Table 21.

1. Typically, the large-scale learning community always happens within the design studio where students do their stuff, including communicating, doing their design work, talking about the group model, and watching videos. Within the learning community, students can have their

**Table 16.** Examples of students who enjoy "sweating".

| Data sources | No. | Contents |
|---|---|---|
| Interview | 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. |
| Focus Group | Student J-Year 2/ Student K-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. |
| | | Yeah, we can only get motivations and inspirations by others through the "sweating" atmosphere. |

**Table 17.** "Sweating" is not available in virtual.

| Data sources | No. | Contents |
|---|---|---|
| Interview | Student A-Year 2 | The "sweating" is obvious in our design studio, but there is no this feeling in other spaces. |
| | Student C-Year 2 | The learning environment motivates us a lot to "sweating" a lot, but there's no this feeling studying in other places. |
| | Student K-Year 3 | I sometimes enjoy learning with my friends in virtual environments, as I have no feelings of "sweating" from others |

**Table 18.** Examples of peer-to-peer bonds due to common race and interests.

| Data sources | No. | Contents |
|---|---|---|
| Focus Group | Student A-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 B-Year 1 | Exactually, we can help each other, cause each of us is good at specific aspects. |
| | Student C-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. |
| | Student J-Year 2 | 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. |

mutual engagement (communications, doing group models and assignments, sharing learning materials, casual chatting, etc.) as the form of a joint enterprise (sweating between each other within the studio environment), and there is one single shared repertoire, which is the ambition to push them to make their design project better compared with others'. In addition, students maintain homogenous peer-to-peer bonds with each other within the learning community.

2. By contrast, the small learning group can be found everywhere, including the design studio, tutorial spaces, learning spaces within other school facilities, public spaces within students' accommodations, and even within the living room where some architecture students live in the same house. The members of the learning group are usually in close relationships, which indicate that the proximity is easy to be observed within the small learning group. In general, wherever architecture students are studying, they tend to organise in a mutual group with common interests, cultural basis, habitus, issues, and aims, which all indicate a shared repertoire to a specific learning group or a learning community.

It is also noticeable that it is difficult to constitute whatever learning communities or learning groups within virtual environments (Table 22).

**Table 19.** Examples of peer-to-peer bonds due to social activities.

| Data sources | No. | Contents |
|---|---|---|
| Interview | 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. |
| | Student D-Year 2 | There are some social activities organised by the Student Association of the Welsh School of Architecture. Some students became close friends after these activities. |
| | Student M-Year 3 | I believe that our relationships relate to social activities. We are all happy to arrange a time on drawing together these days, and we are really in good relationships after these days' work. |
| | Student H-Year 2 | 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. |

**Table 20.** Measures of maintaining peer-to-peer bonds within virtual environments.

| Data sources | No. | Contents |
|---|---|---|
| Interview | Student A-Year 3 | … we (a group of) Chinese students could talk about ideas and share some learning materials on WeChat in efficient |
| | Student D-Year 2 | We use the Miro to upload and share progress materials, and everyone could see others' work there … just like learning within our studio. |
| | 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. |
| | Student E-Year 1 | We generally communicate online through some social media … I even sometimes attend the courses and tutorials on Teams |

**Table 21.** Examples of learning groups and learning communities.

| Data sources | No. | Contents |
|---|---|---|
| Observation | Filed Notes 2.3 (March to May 2022) | Some architecture students' learning experiences usually happen casually, and they generally organise specific learning communities on large scales and/or learning groups on small scales. |
| | Field Notes 2.1 (17th March 2022) | Members of some peer learning groups informally contact each other by means of face-to-face and/or distance methods in the meanwhile, and such members are normally in good relationships or have common interests, concerns, ethics, etc. Such groups normally occur outside the design studio, including public spaces in other university institutions and student accommodations. |
| | Field Notes 1.1 (28th May 2022) | Many students insist on learning only with their close friends or other members of the same design group. Even though, most of their learning time is maintained by asking for help and talking about general issues via distance contact methods. They mostly do not regard informal social aspects as the principal factor in their own learning. |
| | Filed Notes 1.3 and 2.3 (April to May 2022) | A great deal of students prefers learning with specific fellows, constituting a pattern of a learning group. Normally, the members of those learning groups are close friends as well. In addition, compared with those students, there are some other individuals tending to present at the design studio to learn as a whole community. |
| | Filed Notes 1.2 and 2.2 (April to May 2022) | Many students prefer learning within the studio or tutorial space starting around brunch or lunchtime till the evening. Alternatively, some students have found their own ways of learning as a group with others even though they are learning alone within their own homes. |

**Table 22.** Difficulties of generating peer-to-peer bonds within virtual environments.

| Data sources | No. | Contents |
|---|---|---|
| Interview | 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 |
| | Student H-Year 2 | There was no sense that a lot of friends were learning within the same place when we were online during the pandemic … it brings me benefits on my design skills and the sense of working place in the future. |
| | 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 … cause we couldn't see others' clearly … we couldn't share models with others face-to-face … |
| | 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 (within the design studio). I think the suggestions got from persons face-to-face are better than social media. |

## 5. Discussion

### 5.1. Distinct modes of communities of practice

As stated by Morton (2012), participation in the studio environment did not follow a discrete community of practice model, and every student may actively engage in communities of practice

**Table 23.** "Homogenous" and "dispersive" community of practice.

| Genre | Explanation | Characteristics |
|---|---|---|
| Homogenous | The homogeneous learning environment where students have soft connections and competition to achieve better goals. | It is mostly found among the students who stay at their design studio for a whole day every single day. |
| 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. | Some students constitute specific learning groups (typically containing 2–4 people) to cooperatively figure out tough issues, wherever within the design studio or virtual platforms. |

that may not be practical for others. In light of this insight, this paper does not regard the whole group of students in the same academic year or the same school as the community of practice. Specifically, according to the peer learning experiences that happened among many undergraduate architecture students who have specific and settled preferences, there are usually two categories of the community of practice found among such students in this paper, which are "homogenous" community of practice and "dispersive" community of practice respectively (as shown in Table 23).

1. The "homogenous" community of practice is so-called a community of practice that most of the prior literature regarded, which normally means a whole studio and all members within it deem a community to reach a mutual goal (Morton, 2012), such as grasping mutual architectural knowledge or skills (Williams, 2017). The community members in the "homogenous" community of practice are usually home students, who enjoy the "sweating" within the studio environment. Some of them lived in houses, within which bills were not included, so they usually study within the design studio to save their living costs.
2. The "dispersive" community of practice is more connected by a shared repertoire, since the community members are usually friends or specific study companions, who have common cultural backgrounds and interests. Hence, they have more energy and passion to learn novel knowledge and skills from other members within dispersive communities of practice. In addition, they are generally international students, who usually lived in public student accommodations, within which bills are included and served with learning-supportive facilities, so they can regard their own homes and public spaces within their student accommodations as alternative spaces for peer learning.

According to variables that determine the mode of communities of practice, Figure 4 illustrates the matrix of variables of architecture students' peer learning experiences. To distinguish different quadrant by modes of the community of practice, the homogenous mode is marked as Blue colour (the first quadrant), the dispersive mode is marked as Red colour (the third quadrant). It is noticeable that there should be three other modes theoretically, which are isolated mode (marked as Orange colour in the second quadrant), the independent mode (marked as Yellow colour in the fourth quadrant), and the intermodal mode (marked as Green at the central). Table 24 illustrates the description of two main communities of practice between architecture students found in this paper and students' preferences for the specific community.

### 5.2. Architectural peer learning in physical and virtual environments

Beyond findings from previous studies, this paper focuses on architecture students' peer learning outside the formal timetable, providing the thematic characteristics of some architecture students' peer learning experiences happened in physical and virtual learning environments. For example, Vosinakis and Koutsabasis (2013) set up a virtual programme, which was designed for students in different study groups, to discuss and communicate with each other only during course time. My paper reveals that students keep using virtual platform for sharing learning materials and design
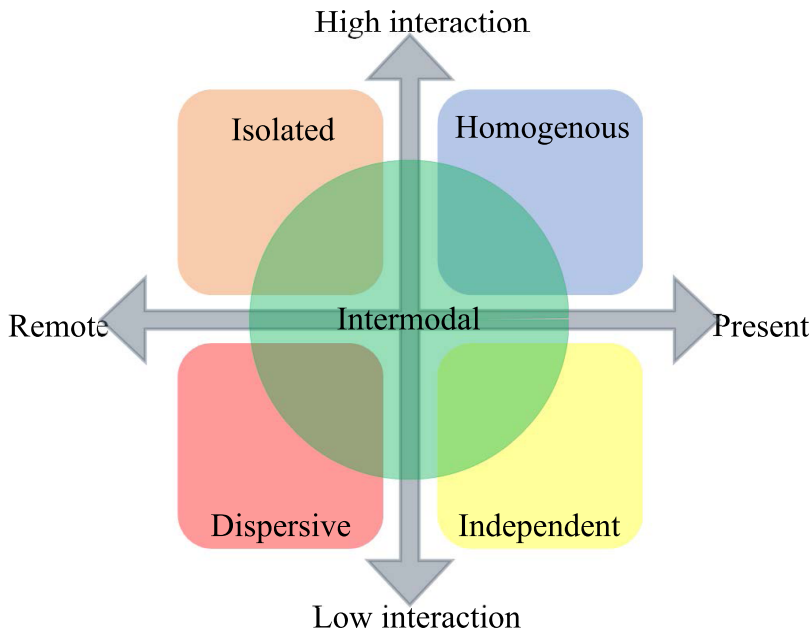
**Figure 4.** Matrix of the variables determining specific community of practice.

ideas even after courses. Moreover, Pektaş (2015) designed a blended-learning design studio, which provided a setting for a rehearsal of future workplaces and helped prepare students for a global, net-worked, and competitive professional design practice. My paper identified that finding that students usually apply face-to-face and distance contact methods simultaneously, to keep a normal inter-action between each other. Similarity, Marshalsey and Sclater (2020) designed an experiment, to explore architecture students' learning experiences before and engaged in online learning, and the results illustrate that the most obvious challenge of peer learning online education needs more personal contact or individual interaction. My paper extends those findings, revealing that the studio environment can ensure students' interactions effectively when they are engaged in virtual environment. For example, Williams (2017) indicated that learning within the community of practice requires both a social dimension and a material practising dimension, but the virtual environment disabled the presence of other students and the right materials, equipment, and spaces which are only reliable in the design studio.

In addition, the study findings demonstrate the design studio provides students with a learning environment characterised by peer-to-peer engagements, including visible peer learning activities and invisible "sweating", which can inspire and motivate their own learning. However, previous studies mainly focused on visible peer learning activities, rather than researching the contribution of the invisible "sweating" between students to students' learning performances and outcomes. Specifically, this paper found that "sweating" largely happens among students in the 2nd- and 3rd academic years, most of whom strongly asserted that "sweating" was pronounced in the design studio. Comparatively, the virtual environment for maintaining "sweating" is still not mature.

### 5.3. Implication to the design studio

The findings of this paper suggest that, to avoid the conditions like physical design studios were sud-denly converted from a physical to a virtual environment during the beginning of the pandemic (Ceylan et al., 2021), the design of a design studio should concurrently enhance the face-to-face and distance contacts between students simultaneously. This implies that there should be various

**Table 24.** Definition of each specific community of practice and their attributes.

| | | Dispersive | Homogenous |
|---|---|---|---|
| Mutual engagement | Students' Preference – Mode of Contact | Students have multiple options to choose their learning spaces and contact methods, especially contacting in remote ways within their own homes. | 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 Environment Suitable for The Specific Mode of Contact | Mutual engagement is maintained by means of physical contact in different dispersive environments, such as learning within the own home and asking for help from others via social media. | The mutual engagement is maintained within a homogenous environment, typically happening within the design studio. |
| A joint enterprise | Students' Preference – Extent of Sweating | Students' peer learning experiences happen within dispersive environments, and students are hardly sweating and contributing to the studio culture. | Students' various interactions generate a joint enterprise as the form of a whole learning community only happened within the design studio, within which students are massive sweating. |
| | Community mode – The Environment Generating the Extent of Sweating | 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 maintained within a homogenous environment where students are mainly massive sweating, contributing to the studio culture. |
| A shared repertoire | Students' Preference – Peer-to-Peer Bonds | Students have specific study fellows learning on a small-scale (normally 2–4 people), and they are generally in good relationships. | Students' shared repertoires generate the homogenous learning community, within which some students study individually, and some others study in small groups simultaneously, and those "study clusters" keep a weak peer-to-peer bond between each other. |
| | Community mode – The Environment Generating the Specific Peer-to-Peer Bonds | A shared repertoire is maintained in different dispersive environments, and students' common interests and preferences in learning styles can be ensured. For example, some students, who prefer studying in a semi-opened space and communicating casually, usually study within a learning unit in the tutorial space. | A shared repertoire is maintained within a homogenous environment where students can do their own stuff and kept in soft relationships with each other. |

types of spaces that not only support physical interactions but also blended-learning activities. For example, the design studio should provide multiple spatial modes for students to conduct small-scale learning groups and large-scale learning communities simultaneously, thereby further satisfying homogenous and dispersive communities of practice both within the design studio. In addition, it was found that the virtual learning environment still cannot entirely substitute the design studio in terms of maintaining the studio environment of the design studio, within which students can walk round and check others' design projects. This finding demonstrated the statement of Komarzyńska-Świeściak et al. (2021). To address this deficiency, it is suggested that AI technologies, which can enable students, who cannot attend peer learning activities in the design studio, to walk around and see others' work, are recommended to create all students' peer-to-peer engagements in virtual environments.

## 6. Limitations and further directions

This paper designs the matrix for illustrating the relationships between each attribute of the community of practice and architecture students' peer learning experiences in informal situations, but it only summarises two quadrants, which are homogenous and dispersive categorises of communities of practice constituted by such experiences. Thus, future relative research can extend the findings of the other two quadrants of each matrix, to explore if there are more modes of architecture students' peer learning experiences when they are outside formal timetable activities. In addition, the characteristics of homogenous and dispersive communities of practice can also be extended, such as by means of quantitative methods to measure each learning individual to further research learning experiences in specific.

Another limitation is that the specific ways of peer learning affect the community of practice need to be found out to further provide references to constitute and renovate architectural design studios and even virtual learning environments. For example, the main reasons affecting students constitute specific genres of communities of practice may include the different structure of the week for different academic years; the long distance from their accommodations to the school; the annoyed environment within the studio; the high replacement of peer learning environment, such as public learning rooms in student accommodations; and the lack of food and drink or other supplements around the design studio; if it is approaching the deadline. Thus, the design outcomes of some students have not reached the level that the academic year should reach. It leads to an exaggerated phenomenon that the gap between students is getting more and more obvious throughout the semester, even though they were initially at the same level of academic learning. Accordingly, the findings of this paper provided further relative research with reference to design "learning architecture" in higher education, especially regarding the dualities of reification and participation, and designed and emergent (Tummons, 2014, pp. 130–131). Besides, the engagement of the community of practice in other disciplines of higher education should be considered as well in future work.

## 7. Conclusions

As the theory of community of practice can reveal details of architecture students' peer learning experiences, this paper applied this theory and found the thematic ways that architecture students constitute their own communities of practice in informal situations outside formal timetable activities. Specifically, the first thematic way is that face-to-face contacts support mutual engagement, which represents that architecture students' interactions are mostly achieved by physical means, despite the fact that the current virtual communication tools can undertake basic idea exchange. The second way is that the studio environment maintains a joint enterprise. This way shows the unreplaceable characteristic of the design studio to architecture students' engagements, which indicates that the studio environment where people are all around and the studio culture within it provide

architecture students with the only place to maintain their daily learning experiences outside their formal timetable activities. The third way is that peer-to-peer bonds constitute a shared repertoire. This way unfolds the motivations of architecture students to make them study within the design studio almost every day because of their shared interests, habitus, cultural basis, etc., constituted by their peer-to-peer bonds. It reveals the significance of an appropriate learning space and experiences, stories, relationships, and difficulties generated from it to architecture students. For instance, a great deal of students believes that the appropriate learning space is absolutely the design studio, and the informal social aspects within it are important to their own learning. Other students think that the space can be anywhere as long as the members of their learning group are presented.

After all, this paper highlighted two specific concepts of the community of practice, which are "homogenous" and "dispersive" community of practice, respectively, according to the scale of community members and the mode of practice. In specific, the "homogenous" community of practice indicates the learning community where multiple students are learning within the design studio, but they are doing their own stuff and casually walking around to see others' working process; the "dispersive" community of practice means that a few of students, who are normally close friends or have the same interests, learn in a small group. This finding leads to the change of design and management of learning environments for architecture students. For example, the design of a studio environment should enhance the face-to-face and distance contacts in the meanwhile between students, which means that there should be multiple genres of spaces supporting not only physical interactions but also blended-learning activities. In addition, it should provide multiple spatial modes within the design studio for students to conduct small-scale learning groups and large-scale learning communities simultaneously to further generate more possibilities for peer-to-peer bonds between students. In other words, the design studio is not a traditional educational space because it provides architecture students with multiple functions but non-dedicated places simultaneously.

## Acknowledgement

## Disclosure statement

No potential conflict of interest was reported by the author(s).

## Author contribution

JW decided the research field; contributed to literature review, methodology, data collection, data analysis and paper writing; and drew conclusions.

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# Appendix

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 <u>only</u>. 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