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Identifying online learning experience of architecture students for a smart education environment

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ABSTRACT

The ongoing COVID-19 pandemic has resulted in a significant change in the field of architecture and design education. Students and educators have been forced to rapidly adopt virtual courses, and returning to the physical classroom in the near future is still uncertain. This study investigates the recent remote learning experiences of tertiary students in Architecture programs through a questionnaire. In addition to the three dimensions of the community of inquiry (Col) framework, including teaching, social, and cognitive presences, spatial presence is explored in this research because learners' presence of space can affect their learning experience. The findings indicate that first- and second-year students have significantly different remote learning experiences than third- to fifth-year students, depending on their experience in face-to-face classes. The extended survey concludes with a discussion of three approaches to reflective learning in online architectural design education. This paper provides systematic knowledge of students' perceptions of distance learning during the pandemic and contributes to developing smart education environments in architectural pedagogy.

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Remote class; learning experience; community of inquiry (Col); social exchange; architectural design education

1. Introduction

Even though universities have recognized the need for online classes or remote learning in the digital era, online or distance education has not been fully integrated into the tertiary education system. However, the COVID-19 pandemic has caused a significant shift in teaching and learning since 2020. Educators have converted their physical classrooms fully or partially to virtual ones, experiencing a digital transformation. In this sudden change, the competency of remote classes has been a critical issue. Past studies have highlighted the need for innovative pedagogy and a unique set of skills for online education that differ from those in the traditional classroom (Fetherston 2001; Hardy and Bower 2004). However, students and educators have faced new pedagogical challenges in a distance class, for example, interaction and digital or technology adoption in a distance class during and after the pandemic.

Furthermore, architecture education traditionally uses a face-to-face studio method that encourages learners to develop their design thinking and solve creative problems (Lee et al. 2021; van Dooren et al. 2018). Unlike general subjects, which address structured problem, architecture education engages students in active learning by presenting them with unstructured problem to analyze alone or as part of a team in order to improve their design expertise (Gallagher and Stepien 1996; Lee and Chung 2008). In

architecture education, learning can be seen as a process of actively constructing meaning based on the learner's individual subjective experience and social interaction in a given situation and context (Savery and Duffy 1995; Hendry 1996). In this process, students acquire knowledge and skills through reflection and problem-solving with the interaction of expert teachers, which is referred to as reflective teaching and learning. In this case, the role of the teacher is just a student's learning facilitator, coach, or guide.

Due to the nature of studio classes, before the COVID-19 pandemic, design education at universities was rarely delivered by online. This pandemic, however, has posed significant challenges to the field of architecture education, with remote online education becoming the only option. Some of these challenges are associated with digital technology and others are related to pedagogy. By the use of an extended questionnaire, this study investigates the architecture students' perceptions of remote education during the pandemic to propose a future direction and an implementation plan for the changing educational environment. This paper then discusses how problem-based learning and reflective practice in architecture can be applied in remote design classes, and how architecture students can improve their learning skills in the face of constantly changing technologies and media.

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2. Theoretical considerations

2.1. *The community of inquiry (Col) framework*

Advances in technology and online learning have significantly changed the educational process. Among the studies on the online learning environment and effectiveness, the community of inquiry (Col) framework developed by Garrison, Anderson, and Archer (2000) is one of the most important educational frameworks in a digital era. This framework originates from Dewey's constructivist approaches to learning in higher education (Garrison and Arbaugh 2007). A sense of community is also formed in online learning, which influences the effectiveness of such education (Thompson and MacDonald 2005). For higher education, it is essential to support collaborative learning and the discourse of a community of learners, which is also significantly related to perceived learning (Shea, Li, and Pickett 2006). The Col framework is a valuable tool for in-depth analysis of these complexities of online learning, providing insight and methodology for online learning (Caskurlu et al. 2021; Garrison 2016).

The Col emphasizes social, cognitive, and teaching presence as essential elements to promote a successful educational experience in an online learning environment. Social presence in online learning means the ability of learners to project themselves socially and emotionally; thus, they can be perceived as "real people" in mediated communication (Gunawardena and Zittle 1997). Social presence has been studied most extensively of the three elements included in the Col, and it is known that various activities that promote social presence improve learner satisfaction (Arbaugh and Benbunan-Fich 2006). Collaborative activities among learners provide additional excellent opportunities to enhance social presence and a greater sense of online community (Richardson and Swan). Social presence is the ability of learners to identify themselves with the community, communicate with others purposefully, and develop interpersonal relationships through projecting their personalities (Garrison, Anderson, and Archer 2000). It is subdivided into the categories of affective expression, open communication, and group cohesion.

Cognitive presence refers to the extent to which learners can construct and confirm meaning through sustained reflection and discourse (Garrison, Anderson, and Archer 2001). Learners enhance their cognitive presence through interaction with each other and critical thinking skills (Duphorne and Gunawardena 2005). Cognitive presence is divided into the categories of triggering event, exploration, integration, and resolution. Teaching presence is concerned with designing, facilitating, and directing cognitive and social processes to realize personally meaningful and educationally valuable learning outcomes (Garrison and Arbaugh 2007). According to Garrison, Anderson,

and Archer (2000), educational presence has three components: instructional design and organization, facilitating discourse, and direct instruction. The design and organization of the online course should be more evident in terms of the planning and design of the structure, process, interaction, and evaluation aspects than the actual classroom instruction. Facilitating discourse involves sharing meaning, identifying areas of agreement and disagreement, and seeking to reach consensus and understanding. It is essential to promote reflection and discourse in direct instruction by presenting content through various evaluations and feedback mechanisms (Garrison and Arbaugh 2007).

In architectural design education, problem-based learning and reflective practice requires both self-directed learning and team-level cooperative learning. Learners must actively participate in the team's decision and be self-directed and active in their duties and activities (Lee and Chung 2008). Active dialogue and exchange of views through the community promote understanding and resolution of unstructured problem situations. As such, there have been many changes in design media in architecture education. For example, building information modeling is a standard for architectural design, construction, and maintenance. Augmented reality/virtual reality (AR/VR) and 3D printing technology are also gradually expanding the scope of their application (Kim 2012). The design medium is not used as a simple tool, but affects the overall design behavior that the designer thinks, expresses, and perceives (Gänshirt 2019). Complexity, asymmetry, non-linearity, and infinite deformability are recently possible with an intuitive interface through generative parametric modeling. Digital models provide virtual form and space, transforming traditional paper-based processes and conventional design sequences (Hensel and Menges 2008; Jang and Kim 2017).

2.2. *Spatial presence*

Rapid advances in communication technology over the past few decades have changed the way people use and experience media. The immersion experience in media has attracted the attention of researchers in various fields, and the basic concept along with it is spatial presence (Lombard and Ditton 1997). Spatial existence is defined as the subjective feeling of the user "being there" in the space embodied by the medium (Ijsselstein and Riva 2003; Slater and Wilbur 1997). Spatial presence refers to experiences created by technologies (i.e., media systems) (Lee 2004; Sheridan 1992). It describes the process in which someone becomes completely immersed in a mediated environment and forgets the "real" world. Instead of maintaining a distance from the media, users feel surrounded by the media environment and become temporarily

less aware of the technological source of their experience. This is also called a “mediated sense of presence.” (Steuer 1992).

Early definitions of spatial existence mention descriptive aspects, such as the degree to which input and output channels of the machine and the human are matched (Schloerb 1995). However, its meaning has been broadly expanded to include psychological understanding, away from technology-oriented definitions and concepts. For example, it refers to a psychological state in which virtual objects are experienced as real objects in either sensory or non-sensory ways (Lee 2004; Ijsselstein 2002). With the advent of psychological conceptualizations, as the psychological aspects as well as the technical aspects of spatial existence were further defined, spatial presence became relevant to cognitive, affective, and physical processes (Hartmann et al. 2015). As vivid spatial illusions and the power of the user’s mind are acknowledged, media other than immersive remote operating systems are also considered capable of evoking the experience of spatial existence (Hartmann et al. 2016). Examples include playing video games (Tamborini and Skalski 2006), watching television (Lee 2004), or even reading a book (Schubert and Crusius 2002), or successful cybertherapy (Price and Anderson 2007).

Research on spatial presence is focused on the process model of the formation of spatial presence (Wirth, Hofer, and Schramm 2012). Spatial existence is understood as the user’s experience of being located within the space described by the media environment rather than the real environment (Wirth, Hofer, and Schramm 2012). This shift in self-location experienced by users means a change in perceived action possibilities. When the user exists spatially, it is considered that the user perceives possible actions within the media environment rather than the real environment. In other words, when spatially present, users feel as if they are in the media environment and perceive their action possibilities within the mediated environment. In this case, the user’s action is not just observation, but participation in the action of the media presentation. Thus, Wirth et al. (2012) indicate that spatial presence can be captured by a combined structure of self-location and perceived possible actions. Spatial presence has been studied in various fields such as computer science, media studies, psychology, engineering, and philosophy, and the academic and practical relevance of concepts is emphasized (Weibel et al. 2015).

2.3. Research on online education during COVID 19

Improving teaching competency, quality of classes, and developing new teaching methods in the new educational environment faced with the COVID-19 pandemic have emerged as critical issues in education

research. Concerns about the appropriate learning model and teaching method for the best learning in such situations appeared. New environments and learning contents of online education were introduced through many studies (Megahed and Hassan 2022; Milovanović et al. 2020; Whittle et al. 2020). The possibility of integrating face-to-face and non-face-to-face was explored (Tambunan, Silitonga, and Sidabutar 2021), and a convergence method of augmented interaction between professor and student, and student and student was sought (Siripongdee, Pimdee, and Tungwongwanich 2020; Dhawan 2020; Dhawan and Batra 2021).

Architecture education has moved online without exception. Several studies have dealt with these radical changes in architectural education. Instead of an on-site studio, an online studio was established for students, and various practical contributions and experiences brought about by technological development were studied in class. Such studies examined the effect of a technology-based educational environment on architecture education (Megahed and Hassan 2022; Milovanović et al. 2020; Hassanpour 2022; Saghaei and Crowther 2021; Al Maani, Alnusairat, and Al-Jokhadar 2021). Studies on architectural education generally predict that studio education after the COVID-19 pandemic will not be the same as traditional education in the past. Therefore, it is argued that the transformative change in education caused by the COVID-19 crisis will continue even after COVID-19 and a vision and strategy to reimagine education after COVID-19 is necessary (Megahed and Hassan 2022; Hassanpour 2022). Students strong presence and interaction in the online studio affect the educational environment, emphasizing the importance of the studio’s social network and open communication (Hassanpour 2022). Factors that enhance design learning were discovered by examining experiences in online design studios, and methods for pedagogical developments were sought (Milovanović et al. 2020). Although students during the post-COVID-19 period had a difficult experience in an online design studio, positive aspects of online education also appeared (Al Maani, Alnusairat, and Al-Jokhadar 2021). Also, a suitable and balanced blended learning strategy has been proposed for architectural design education (Megahed and Hassan 2022).

Although the design studio, where students learn by doing and reflect on their design activities, is at the heart of all architectural design education (van Dooren et al. 2018), the nature of architectural design education is conceptually in line the Col framework. Since the Col is a validated tool for evaluating the learning potential and collaborative learning in a technology-mediated environment, this study used the social presence, cognitive presence, and teaching presence of the Col to analyze the online learning experience of

students in architecture. This study also includes the concept of spatial presence in addition to the Col since the concept of spatial presence is very relevant to understanding, describing, and predicting user experience in online classrooms.

3. Method

3.1. Participants

Participants were undergraduate architecture students who took remote classes from the first semester of 2020 to the first semester of 2021. Stratified random sampling was used to develop two groups of participants (students who had experienced face-to-face classes and those who had not) after a pilot survey. A total of 104 online questionnaires (60 males and 44 females) were collected and used for this analysis. 54 first- and second-year students had not experienced face-to-face classes at university after admission because of the COVID-19 pandemic and the remainder was third to fifth-year students who had experienced both face-to-face and remote classes.

3.2. The LMS settings

Participating students' universities used LMS (Learning Management System) developed based on Blackboard Learn. LMS is the most widely used web-based learning environment in Korea for learning activities and the management of learners. The primary functions of LMS include course management, learning content sharing, learning record, task management, evaluation management, and community management. Table 1 shows the functions for enhancing the learning activities of learners in LMS.

In the LMS system, the instructor can monitor the learning process, give detailed feedback to students, and check the analysis of data related to learning activities. Students have the freedom to listen to recorded lectures without restrictions on the learning time and place. They can repeatedly listen to the recorded lectures for parts that are difficult to understand, thus students in the LMS environment plans and executes learning proactively. In the case of recorded lectures, students listened to the class and sent instructors their questions by message or e-mail. The

instructors answered and explained the frequently asked questions in the following lecture. When sharing and viewing data on the screen, it is beneficial to understand better than in face-to-face classes and to listen to feedback from other students.

3.3. Questionnaire

The Figure 1 shows the process of the questionnaire survey.. To investigate students' remote online learning experience, this research adopted Arbaugh et al.'s (2006) Col survey and revised it to fit in architectural design education. The questionnaire initially contained 27 items. There were nine items in each of the three categories of social presence, cognitive presence, and teaching presence. Importantly, by considering spatial presence experience to be an important component of students' remote learning experience in this paper, a new dimension, spatial presence, was added to the survey. The spatial presence experience scale (SPES) of Hartmann et al. (2016) was utilized for the development of the spatial presence consisting of the two sub-dimensions (self-location and possible action). A total of 10 items were identified for the spatial presence. Five items reflected users' self-location and five items reflected their perceived possible actions. 37 items for the four dimensions of learning experience (Col and SPES) were included in the questionnaire. This extended questionnaire used a 5-point Likert scale ranging from 1 ("I do not agree at all") to 5 ("I fully agree"). Reliability of the modified Col and SPES items was measured by Cronbach's coefficient. All The Cronbach's alpha values of the items (social presence: .91, cognitive presence: .85, teaching presence: .93, and spatial presence: .81) exceeded .80, indicating that the four sets of items were internally constituent and reliable.

3.4. Procedure

A pilot survey was conducted with the students. After confirming the survey tool and response patterns, a main online survey used stratified random sampling to examine the differences between the two groups of students. Data were collected in June 2021. The collected data was analyzed by SPSSWIN 23.

Table 1. Functions for learners provided by LMS.

Functions	Learning activities
Learner support	Lecture recording/playback/data sharing
Learner individual learning information/participation history/ database management	Video streaming, screen sharing, document creation and sharing
Interaction between instructors and learners	Attendance, participation data, time tracking, learning results
Mobile Learning Environment	Presentation, discussion, Q&A, quiz, survey
Cloud Learning Environment	Learning from any device and anywhere
	Cloud recording and playback

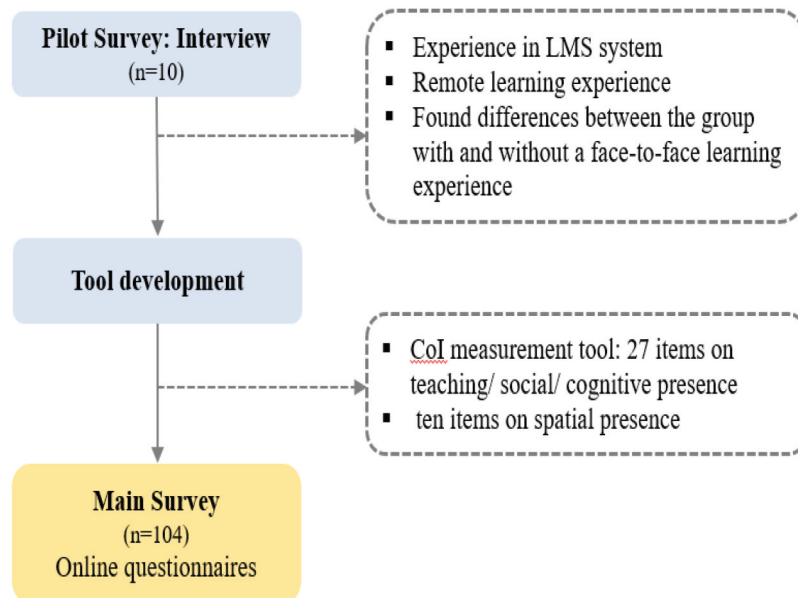


Figure 1. The process of the questionnaire survey.

4. Four dimensions of learning experience

4.1. Teaching presence

The results of teaching presence, the first dimension of learning experience, are shown in Table 2. The highest score was 4.33, indicating that “The instructor clearly communicated important due dates/time frames for learning activities.” The next highest were for “The instructor was helpful in guiding the class towards understanding course topics in a way that helped me clarify my thinking” (4.08) and “The instructor provided clear instructions on how to participate in course learning activities” (4.00). The lowest score was for “Instructor actions reinforced the development of a sense of community among course participants” (3.04 points). In addition, the scores for “The instructor helped keep the course participants on task in a way that helped me to learn (3.38)” and “The instructor helped to focus discussion on relevant issues in a way that helped me to learn” (3.38) were low. This result implies that students feel that the support of classes

related to learning itself is high, but that it is insufficient to create a cooperative learning environment for students. In the results for teaching presence, there was a statistically significant difference between third- to fifth-year students who had experienced face-to-face classes and first- and second-year students who had not experienced these classes. It was found that most of the third- and fifth-year students had higher scores on the teaching presence items than did the first- and second-year students, contrary to the expectation that students’ teaching presence scores for online education would not be high. Thus, the third- to fifth-year students seem to be adjusting well to remote education.

4.2. Social presence

Students’ scores for social presence are shown in Table 3. Overall, these scores were low. An interesting result is that, after answering “online or web-based communication is an excellent medium for social

Table 2. Teaching presence.

	Total (n = 104)		Years 1 and 2 (n = 54)		Years 3–5 (n = 50)		t-value
	M	SD	M	SD	M	SD	
The instructor clearly communicated important course topics	3.88	0.82	3.67	0.77	4.12	0.82	–2.88 **
The instructor provided clear instructions on how to participate in course learning activities	4.00	0.90	3.89	0.92	4.12	0.87	–1.30
The instructor clearly communicated important due dates/time frames for learning activities	4.33	0.80	4.11	0.88	4.56	0.64	–2.94**
The instructor was helpful in guiding the class towards understanding course topics in a way that helped me clarify my thinking	4.08	0.85	3.85	0.89	4.32	0.74	–2.88**
The instructor helped to keep course participants engaged and participating in productive dialogue	3.88	0.99	3.59	1.03	4.20	0.85	–3.24**
The instructor helped keep the course participants on task in a way that helped me to learn	3.38	1.15	3.26	1.21	3.52	1.07	–1.15
Instructor actions reinforced the development of a sense of community among course participants	3.04	1.18	2.67	1.16	3.44	1.07	–3.51**
The instructor helped to focus discussion on relevant issues in a way that helped me to learn	3.38	1.15	3.07	1.22	3.72	0.97	–2.96**
The instructor provided feedback in a timely fashion	3.69	1.08	3.44	1.20	3.96	0.88	–2.47 *

(* p < .05, ** p < .01)

Table 3. Social presence.

	Total (n = 104)		Years 1 and 2 (n = 54)		Years 3–5 (n = 50)		t-value
	M	SD	M	SD	M	SD	
Getting to know other course participants gave me a sense of belonging in the course	2.56	1.29	2.26	1.18	2.88	1.35	–2.49 *
I was able to form distinct impressions of some course participants	3.23	1.09	3.04	1.14	3.44	0.99	–1.90
Online or web-based communication is an excellent medium for social interaction	3.85	0.97	3.81	0.95	3.88	1.00	–0.34
I felt comfortable conversing through the online medium	3.23	1.15	3.19	1.23	3.28	1.08	–0.41
I felt comfortable participating in the course discussions	2.85	1.12	2.63	1.06	3.08	1.14	–2.07*
I felt comfortable interacting with other course participants	2.65	1.18	2.56	1.23	2.76	1.11	–0.88
I felt comfortable disagreeing with other course participants while still maintaining a sense of trust	2.17	1.16	2.11	1.11	2.24	1.22	0.57
I felt that my point of view was acknowledged by other course participants	3.31	0.99	3.15	0.94	3.48	1.03	–1.71
Online discussions help me to develop a sense of collaboration	2.96	1.11	2.78	1.00	3.16	1.20	–1.76

(* p < .05)

interaction" (3.85), for the opposite question, they said "I felt comfortable disagreeing with other course participants while still maintaining a sense of trust" (2.17). The low scores were given to items such as "Getting to know other course participants gave me a sense of belonging in the course" (2.56) and "I felt comfortable interacting with other course participants" (2.65). These results show that there is little social interaction in current remote classes contrary to students' beliefs that online communication enables social interaction; therefore, they remain silent and do not express themselves and interact with others. In the results for social presence, there was a statistically significant difference between third- to fifth-year students who had experienced face-to-face classes and first- and second-year students who had not. Compared with first- and second-year students, third to fifth-year students felt a sense of belonging in remote classes (2.88) or more comfortable participating in discussions in remote classes (3.08).

4.3. Cognitive presence

Students' scores for cognitive presence are shown in Table 4. The highest score was 3.94, indicating that "I utilized a variety of information sources to explore problems posed in this course." The next highest scores were for "I have developed solutions to course problems that can be applied in practice" (3.77), and "I can apply the knowledge created in this course to my work or other non-class related activities" (3.75). As expected, the items with the lowest scores were interest in course issues (3.42), stimulation of curiosity

(3.46), and online discussion (3.46). Respondents were positive about information utilization, knowledge application, and problem-solving in online education, but less positive about interest in the course, intellectual curiosity, and creativity. The table shows that the deviation between the scores for the highest item (3.77 points) and the lowest item (3.42 points) was 0.35 points. Thus, compared with teaching presence (1.29, see Table 2) and social presence (1.29, see Table 3), there was no significant difference in cognitive presence items. The response scores for each item were all in the range of three to four points. There was a statistically significant difference between third- to fifth-year students and first- and second-year students. Most of third- to fifth-year students had higher scores on the cognitive presence items than the first- and second-year students, notably "problems posed increased my interest in course issues (3.80)," and "I have developed solutions to course problems that can be applied in practice" (4.08).

4.4. Spatial presence

Table 5 shows the results for spatial presence consisting of "self-location" and "possible action". A score of 4 or more was not shown. The score for the first item, "I felt like I was actually in a classroom environment," was the lowest (2.72) in "self-location". There was a statistically significant difference between third to fifth-year students and first- and second-year students. Compared with the first- and second-year students, most of the third- to fifth-year students felt more strongly as if they

Table 4. Cognitive presence.

	Total (n = 104)		Years 1 and 2 (n = 54)		Years 3–5 (n = 50)		t-value
	M	SD	M	SD	M	SD	
Problems posed increased my interest in course issues	3.42	0.99	3.07	0.94	3.80	0.90	–3.98***
Course activities piqued my curiosity	3.46	1.03	3.30	0.98	3.64	1.06	–1.71
I felt motivated to explore content related questions	3.58	0.99	3.48	0.92	3.68	1.05	–1.02
I utilized a variety of information sources to explore problems posed in this course	3.94	1.05	3.67	1.09	4.24	0.91	–2.87**
Online discussions were valuable in helping me appreciate different perspectives	3.46	0.95	3.48	0.92	3.44	0.99	0.22
Learning activities helped me construct explanations/solutions	3.67	0.99	3.59	1.00	3.76	1.00	–0.85
Reflection on course content and discussions helped me understand fundamental concepts in this class	3.71	0.88	3.52	0.92	3.92	0.80	–2.35*
I have developed solutions to course problems that can be applied in practice	3.77	0.89	3.48	0.96	4.08	0.69	–3.60***
I can apply the knowledge created in this course to my work or other non-class related activities	3.75	1.00	3.48	1.04	4.04	0.88	–2.94**

(* p < .05, ** p < .01, ***p < .001)

Table 5. Spatial presence.

	Total (n = 104)		Years 1 and 2 (n = 54)		Years 3–5 (n = 50)		t-value
	M	SD	M	SD	M	SD	
Self-isolation							
I felt like I was actually in a classroom environment	2.72	1.31	2.87	1.33	2.56	1.28	1.20
I felt as if I was attending a class	3.56	1.23	3.07	1.25	4.08	0.98	−4.51***
I felt like I was participating in the behaviors occurring in the online class rather than just observing	3.37	1.15	2.93	1.24	3.84	0.84	−4.35***
I am not very aware of what is happening in my physical environment (around objects, people, or sounds) while taking online classes	3.04	1.23	3.00	1.25	3.08	1.20	−0.33
I did not have difficulty concentrating in class when I take online classes in my relaxing private space (my room)	2.92	1.25	2.81	1.29	3.04	1.22	0.36
Possible actions							
In the online education system, I had the impression that I could do activities related to classes	3.31	1.20	3.26	1.01	3.76	0.82	−2.75**
I felt like I was learning hard in the remote class	3.50	0.95	3.30	1.16	3.80	0.90	−2.45*
I felt that the experience of learning in online classes matches the experience of learning in real classes	3.54	1.07	3.04	1.33	3.08	1.17	−0.17
I was comfortable operating the online education system (text, visual and auditory media) associated with remote classes	3.26	1.25	3.37	1.13	3.16	1.36	0.39
I have not often experienced system lag during class, or the screen not responding immediately as intended	2.69	1.20	2.88	1.14	2.48	1.24	0.08

(* $p < .05$, ** $p < .01$, *** $p < .001$)

were attending an actual class (4.08) or participating in behaviors occurring in a remote class (3.84).

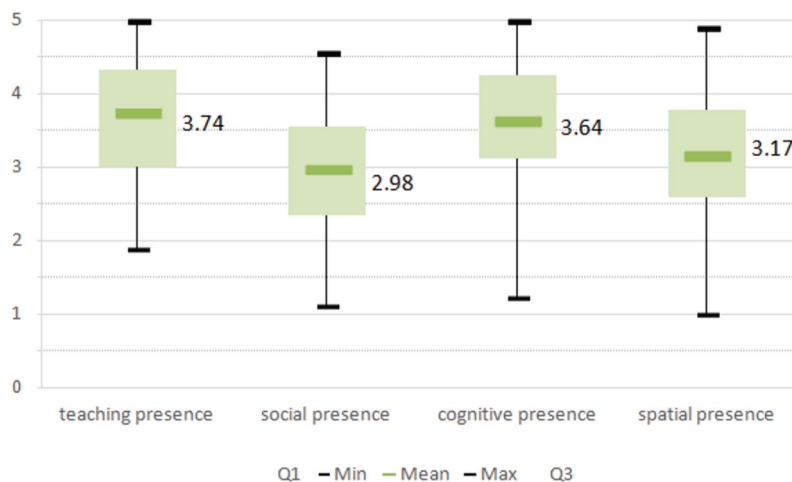
Interestingly, the students observed system lag or the screen not responding could hinder the possible actions (2.69) while they felt the experience of learning in online classes matches the experience of learning in real classes (3.54). Furthermore, there was a statistically significant difference between first- and second-year students and third- to fifth-year students the latter group felt more strongly that they could engage in class-related activities in an online educational environment (3.76) or learn diligently in remote classes (3.80), compared with the former.

A comparison of the four types of presence is shown in Figure 2. Students' social presence was the lowest ($M = 2.98$, $SD = 0.84$), followed by spatial presence ($M = 3.17$, $SD = 0.73$). Cognitive presence ($M = 3.64$, $SD = 0.78$) and teaching presence ($M = 3.74$, $SD = 0.77$) had the higher evaluation scores compared to those of social presence and spatial presence. As expected, the

result suggests that students are experiencing difficulties in social interaction, sense of belonging, and exchange in remote education. Furthermore, to increase the positive experience of students in remote learning, architectural design education does not only identify various ways to secure social presence, leading to a sense of community among students, but also provide an appropriate sense of spatial presence.

5. Discussion

Owing to the COVID-19 pandemic, architectural design courses on campus were suddenly changed to remote classes. Distance learning will continue in architectural education because of the current pandemic situation and the advantages these classes offer. In this context, this study explored architecture students' remote learning experiences and cases recently conducted in the Department of Architecture and analyzed the current status of remote education from the students'

**Figure 2.** The average scores of four dimensions of learning experience.

perspective. The analysis results revealed that there was a significant difference between students who had not experienced face-to-face classes (years 1 to 2) and students who had experienced face-to-face classes (years 3 to 5). As a result of overall satisfaction with remote classes and Col analysis, students who had experienced face-to-face classes scored higher than those who had not experienced face-to-face classes in social, teaching, and cognitive presence. Students who had experienced face-to-face classes were more satisfied with remote classes, more positive, and more actively participating in remote classes. It seems that the third- to fifth-year students' real-world experiences and social interactions in campus affected their remote education.

When the first- and second-year students were asked to identify the most difficult part, they stated that they spent most of time alone in class, felt isolated, and did not know a classmate with whom they could collaborate. For first-year students, college life was adversely affected because of the lack of face-to-face interaction with peers; thus, they were passively engaged in classes. Some fourth-year students were listening to the class together with some close friends they already knew while working on assignments and communicating. They created a social environment that the teacher was unaware of, and in that environment, they were communicating with their close friends while listening to remote classes. For example, they installed two monitors and listened to a class while talking with five close friends through a program or opened a group chat between close friends and participated in a class by asking questions. The findings of this paper suggest that social interaction and exchange are very important for students participating in online learning. It is also evident that student interactions on real campuses can promote positive remote learning experiences. Thus, a hybrid mode of course delivery is recommended, while this paper further discusses about three approaches to reflective teaching and learning in remote architectural design education.

5.1. Building a community of learners physically and virtually

Building a community of learners in which students collaborate and learn together can be a powerful motivator for learning expansion (Collins 2006). In this study, students also valued the sense of community as important, but unlike in the face-to-face classes, the learner community was not well established in the remote classes, making it difficult for students to communicate with other students. It seems that they could only feel the presence of other students while connected to the camera and speaker and did not feel a sense of community in which they could study together and ask each other questions about the

class content. That is why first- and second-year students who have a low sense of belonging wanted to freely share assignments and questions with other students taking the same class, through chat rooms in the online system. In the Col analysis result, the social presence score was also the lowest. Students thought that online or web-based communication was an excellent medium for social interaction, but in remote classes, they were often silent because it was difficult to express their opinions and interact with others. It seems that the low sense of community discouraged their social exchanges.

In terms of the teaching presence analysis, students thought that the support related to the teacher's learning activities (e.g., the subject's goal, topic, method of participating in learning activities, and important deadlines or schedules) was good but that the creation of an environment for cooperative learning was insufficient. It seems that students expected meaningful feedback from classmates as well as personal guidance from teachers. If a cooperative learning environment is created in remote classes, students could share their point of view with other students, seek the opinions of their friends, encourage each other, and exchange information, which would enable them to reflect on their learning and development. Building a learner community for the cooperative learning environment can be enabled by course design and meaningful actions by peers and educators. To this end, professors and course designers must support social or cognitive interaction, create a welcoming environment physically and virtually, and carefully provide opportunities and methods for students to communicate. Careful consideration should be given to how to create the most effective and interactive learning community.

5.2. Appropriate online class format according to class content

The students thought the most important element in remote classes was that the class content should be suitable for online courses. In the process of rapidly changing from face-to-face classes to remote online classes at universities, professors may have applied the content of face-to-face classes directly to that of remote classes. However, students demanded the use of visual materials suitable for the online teaching and of content suitable for the changed medium. Previous studies have reported that students preferred synchronous online communication in remote classes, which allows them to recognize and respond to others easily (Borup, West, and Graham 2012; Cox, Carr, and Hall 2004). However, this study found that students preferred text-based recorded lectures in some cases since they can utilize efficiently the listening and capturing functions of the recorded lectures, which is not possible in a face-to-face class. For theoretical subjects, the

students preferred the recorded lectures, which they could listen repeatedly or listen to the parts with which they were unfamiliar. This study implies that real-time video lectures would be appropriate when interaction through collaboration or discussion is required, such as professors' immediate reaction and feedback and students' active participation and responses to other students' inquiries.

Contrary to concerns that it would be difficult for practical classes to be conducted online, students were relatively satisfied with online studio classes since they could observe professors' critique of other students' works through the screen during the remote class. The studio class, which combines online and offline classes, was able to satisfy the intrinsic desire of new students to become a member of the community of the Department of Architecture. The mixed studio course of face-to-face and online classes gave first-year students an opportunity to make friends and provided a sense of belonging to the department. It seems that the peer relationship in the studio had a positive effect on the class; thus, students could feel a sense of community, unlike in other majors. As remote online classes increased, more computer work was performed, and students were feeling a change in the way they perceived the space. Therefore, the results of this study suggest that various online class types should be developed according to the content of the class for effective remote education. More diverse class formats, such as recorded, real-time online, both recorded and real-time online, and blended (face-to-face and online) should be provided to students.

5.3. A physical learning environment for remote learning

The students thought that the role of a physical space suitable for online classes was very important. Most students in the survey were taking classes in private bedrooms or studio rooms. Owing to the nature of the online class, they must turn on the camera and the microphone to feel connected to other people. However, they wanted to turn off the camera and microphone as far as possible for fear that their personal space would be exposed or that unwanted sounds or conversations would be transmitted to the class. Media immersion enhances presence experiences (Weibel et al. 2015). In discussing media immersion for online learning environments, often, attention is paid to the implementation of the immersive online learning space. However, disturbance in the physical space also causes problems in students' concentration and immersion in remote class. Without a suitable place for remote learning, students might have difficulties in feeling that they are participating in class or are actually attending class. Therefore, an appropriate physical space is a prerequisite for remote classes. Even

if it is not the same space as the classroom, it is desirable to create a place to listen only to classes using the living room and study room in the house. At least, a territorial separation should be made between places for remote learning and the private bedroom space for sleeping and resting.

Recent research has been a meaningful discussion on a vision to reimagine the educational environment after the pandemic. In addition to the impact of the technology-based educational environment on architecture education, the online design studio experienced by students is analyzed from various aspects. Students should be able to learn new knowledge, interact with peers, and integrate with various technologies in online studios, just like in conventional studio classes (Al Maani, Alnusairat, and Al-Jokhadar 2021). Students need to adapt to these situations and cope with new learning identities that demand greater responsibility and independence. Looking at the SWOC analysis of students' online classes in a crisis such as the COVID-19 pandemic, the learner's capability & confidence level are pointed out as essential issues. However, this crisis can be seen as an opportunity for an innovative pedagogical approach, such as radical transformation in all aspects of education (Dhawan 2020). In online education, specificity according to grade is a critical issue to consider. A study of first-year students with no studio experience suggests that these grade-specific contexts are an essential issue in online education research (Hassanpour 2022). To promote learning in an online design studio, a differentiated educational strategy is required according to the diversity and individuality of students. Some studies have suggested a blended learning strategy as an alternative model (Megahed and Hassan 2022; Siripongdee, Pimdee, and Tungwongwanich 2020). However, even in blended learning, the degree of technology integration to derive the best learning results, the right combination between various teaching and learning activities, and the effectiveness of the blended delivery method remain significant challenges to be solved.

6. Conclusion

This study identified current problems of remote classes in architecture education and suggested a desirable direction for future remote classes. Interactions are essential between instructors and learners but adjusting the scope of interactions should be carefully considered. For example, students want information-sharing space that instructors cannot know about. A community of learners in which students share information related to remote classes and discuss with other classmates is one of the critical components of the cooperative learning environment. LMS is mainly a one-way delivery environment centered on

instructors and consists of a conventional user interface. Interactive communication and collaborative learning are strengthening, but the LMS environment does not have a function to support small group activities to promote relationships between learners. Students use separate apps or social media to share learning materials and communicate with members. To support the interactive learning activities, functions that support one-to-one feedback and small group activities between learners should be added to LMS.

Further, the results of this study show that students' experiences and social interactions in a real environment affected students' remote learning experience. Since design education is about strengthening learning through community formation, it should be changed to a learning support system that emphasizes the interaction of learning activities according to the context of the learner. Without a sense of community, students had difficulties communicating and collaborating with other students in virtual courses. College students who have experienced distance learning hoped that online classes would not disappear and be used even after the COVID-19 pandemic. Appropriate online classes would provide students with a sense of community and increase membership, friendship, solidarity, and satisfaction. Universities and teachers should carefully consider how to support student learning experience and motivation when designing courses based on the results of this analysis. The online teaching experience of teachers will be investigated and analyzed in future research.

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References

- Al Maani, D., S. Alnusairat, and A. Al-Jokhadar. 2021. "Transforming Learning for Architecture: Online Design Studio as the New Norm for Crises Adaptation under COVID-19." *Open House International* 46 (3): 348–358. doi:10.1108/OHI-01-2021-0016.
- Arbaugh, J. B., and R. Benbunan-Fich. 2006. "An Investigation of Epistemological and Social Dimensions of Teaching in Online Learning Environments." *Academy of Management Learning & Education* 5 (4): 435–447. doi:10.5465/amle.2006.23473204.
- Borup, J., R. E. West, and C. R. Graham. 2012. "Improving Online Social Presence through Asynchronous Video." *The Internet and Higher Education* 15 (3): 195–203. doi:10.1016/j.iheduc.2011.11.001.
- Caskurlu, S., J. C. Richardson, Y. Maeda, K. Kozan. 2021. "The Qualitative Evidence behind the Factors Impacting Online Learning Experiences as Informed by the Community of Inquiry Framework: A Thematic Synthesis". *Computers & Education* 165: 104111. doi:10.1016/j.compedu.2020.104111.
- Collins, A. 2006. *Cognitive Apprenticeship, in the Cambridge Handbook Of: The Learning Sciences*, 47–60. New York, NY, US: Cambridge University Press.
- Cox, G., T. Carr, and M. Hall. 2004. "Evaluating the Use of Synchronous Communication in Two Blended Courses."

- Computer Assisted Learning* 20 (3): 183–193. doi:10.1111/j.1365-2729.2004.00084.x.
- Dhawan, S. 2020. "Online Learning: A Panacea in the Time of COVID-19 Crisis". *Journal of Educational Technology Systems*. 49 (1): 5–22.
- Dhawan, S., and G. Batra. 2021. *Artificial Intelligence in Higher Education: Promises, Perils, and Perspective*. Ghaziabad, India: OJAS: Expanding the Knowledge Horizon, Jaipuria School of Business.
- Duphorne, P. L., and C. N. Gunawardena. 2005. "The Effect of Three Computer Conferencing Designs on Critical Thinking Skills of Nursing Students." *American Journal of Distance Education* 19 (1): 37–50. doi:10.1207/s15389286ajde1901_4.
- Fetherston, T. 2001. "Pedagogical Challenges for the World Wide Web." *AACE Review (Formerly AACE Journal)* 9 (1): 25–32.
- Gallagher, S. A., and W. J. Stepien. 1996. "Content Acquisition in problem-based Learning." *The Education of the Gifted* 19 (3): 257–275. doi:10.1177/016235329601900302.
- Gänshirt, C. 2019. *Tools for Ideas: An Introduction to Architectural Design*. Basel, Switzerland: Birkhäuser Architecture.
- Garrison, D. R. 2016. *E-Learning in the 21st Century: A Community of Inquiry Framework for Research and Practice*. London: Routledge.
- Garrison, D. R., T. Anderson, and W. Archer. 2000. "Critical Inquiry in a text-based Environment: Computer Conferencing in Higher Education." *Internet and Higher Education* 2 (2–3): 87–105. doi:10.1016/S1096-7516(00)00016-6.
- Garrison, D. R., T. Anderson, and W. Archer. 2001. "Critical Thinking and Computer Conferencing: A Model and Tool to Assess Cognitive Presence." *American Journal of Distance Education* 15 (1): 7–23. doi:10.1080/08923640109527071.
- Garrison, D. R., and J. B. Arbaugh. 2007. "Researching the Community of Inquiry Framework: Review, Issues, and Future Directions." *The Internet and Higher Education* 10 (3): 157–172. doi:10.1016/j.iheduc.2007.04.001.
- Gunawardena, C., and F. Zittle. 1997. "Social Presence as a Predictor of Satisfaction within a Computer Mediated Conferencing Environment." *American Journal of Distance Education* 11 (3): 8–26. doi:10.1080/08923649709526970.
- Hardy, K. P., and B. L. Bower. 2004. "Instructional and Work Life Issues for Distance Learning Faculty." *New Directions for Community Colleges* 2004 (128): 47–54. doi:10.1002/cc.174.
- Hartmann, T., W. Wirth, H. Schramm, C. Klimmt, P. Vorderer, A. Gysbers, S. Böcking, et al. 2016. "The Spatial Presence Experience Scale (SPES): A Short self-report Measure for Diverse Media Settings." *Media Psychology* 28 (1): 1–15. doi:10.1027/1864-1105/a000137.
- Hassanpour, B. 2022. *Transformational Contribution of Technology to Studio Culture: Experience of an Online first-year Architecture Design Studio during the COVID-19 Pandemic. ahead-of-print*. Archnet-IJAR: International Journal of Architectural Research.
- Hendry, G. D. 1996. "Constructivism and Educational Practice." *Australian Journal of Education* 40 (1): 19–45. doi:10.1177/000494419604000103.
- Hensel, M., and A. Menges. 2008. "Inclusive Performance: Efficiency versus Effectiveness Towards a morpho-ecological Approach for Design." *Architectural Design* 78 (2): 54–63. doi:10.1002/ad.642.
- Ijsselstein, W. A. 2002. "Elements of a multi-level Theory of Presence: Phenomenology, Mental Processing and Neural Correlates." PRESENCE 2002 – 5th annual international workshop on presence. PRESENCE.
- Ijsselstein, W., and G. Riva. 2003. "Being There: The Experience of Presence in Mediated Environments". Giuseppe Riva, Fabrizio Davide, Wijnand A. Ijsselstein. In *Being There: Concepts, Effects and Measurements of User Presence in Synthetic Environments*, 3–16. Amsterdam, Netherlands: IOS Press.
- Jang, D. J., and S. A. Kim. 2017. "Proposing a Pedagogic Process of Digital Modeling for performance-oriented Design." *The Architectural Institute of Korea Planning & Design* 33 (6): 39–48.
- Kim, S. 2012. "Digital Architecture and BIM." *Architecture and Building Science* 56 (11): 15–18.
- Lee, K. M. 2004. "Presence, Explicated." *Communication Theory* 14 (1): 27–50. doi:10.1111/j.1468-2885.2004.tb00302.x.
- Lee, D. Y., and H. M. Chung. 2008. "Investigating Constructivist Approach to Design Studio Courses in Universities of U.S.A and U.K." *The Architectural Institute of Korea Planning & Design* 24 (6): 149–160.
- Lee, J. H., M. J. Ostwald, N. Gu, M. Roberts. 2021. "Linguistic and Cultural Perspectives on Globalised Design Education." *International Journal of Technology and Design Education*. 31 (1): 165–181. doi:10.1007/s10798-019-09544-2.
- Lombard, M., and T. Ditton. 1997. "At the Heart of It All: The Concept of Presence." *Computer-Mediated Communication* 3 (2). No Pagination Specified–No Pagination Specified.
- Megahed, N., and A. Hassan. 2022. "A Blended Learning Strategy: Reimagining the post-Covid-19 Architectural Education." *Archnet-IJAR: International Journal of Architectural Research* 16 (1): 184–202. doi:10.1108/ARCH-04-2021-0081.
- Milovanović, A., M. Kostić, A. Zorić, A. Đorđević, M. Pešić, J. Bugarski, D. Todorović, N. Sokolović, A. Josifovski. 2020. "Transferring covid-19 Challenges into Learning Potentials: Online Workshops in Architectural education. Sustainability." 12(17): 7024.
- Price, M., and P. Anderson. 2007. "The Role of Presence in Virtual Reality Exposure Therapy." *Journal of Anxiety Disorders* 21 (5): 742–751. doi:10.1016/j.janxdis.2006.11.002.
- Richardson, J. C., and K. Swan. 2020. Examining Social Presence in Online Courses in Relation to Students' Perceived Learning and Satisfaction." *Journal of Asynchronous Learning Networks*. 12 (17): 68–88.
- Saghafi, M. R., and P. Crowther. 2021. "Integrating Technology Subjects with Design Studio Teaching: Comparing Curriculum of Architecture Education in Australia and Iran." *Archnet-IJAR: International Journal of Architectural Research* 15 (3): 652–667. doi:10.1108/ARCH-08-2020-0160.
- Savery, J. R., and T. M. Duffy. 1995. "Problem Based Learning: An Instructional Model and Its Constructivist Framework." *Educational Technology* 35 (5): 31–38.
- Schloerb, D. W. 1995. "A Quantitative Measure of Telepresence." *Presence: Teleoperators and Virtual Environments* 4 (1): 64–80. doi:10.1162/pres.1995.4.1.64.
- Schubert, T., and J. Crusius. 2002. "Five Theses on the Book Problem: Presence in Books, Film and VR." PRESENCE 2002-the 5th international workshop on presence. Universidad Fernando Pe.
- Shea, P., C. S. Li, and A. Pickett. 2006. "A Study of Teaching Presence and Student Sense of Learning Community in Fully Online and web-enhanced College Courses." *The Internet and Higher Education* 9 (3): 175–190. doi:10.1016/j.iheduc.2006.06.005.

- Sheridan, T. B. 1992. "Musings on Telepresence and Virtual Presence." *Presence: Teleoperators and Virtual Environments* 1 (1): 120–126. doi:10.1162/pres.1992.1.1.120.
- Siripongdee, K., P. Pimdee, and S. Tungwongwanich. 2020. "A Blended Learning Model with IoT-based Technology." *Journal for the Education of Gifted Young Scientists* 905–917. doi:10.17478/jegys.698869.
- Slater, M., and S. Wilbur. 1997. "A Framework for Immersive Virtual Environments Five: Speculations on the Role of Presence in Virtual Environments." *Presence: Teleoperators and Virtual Environments* 6 (6): 603–616. doi:10.1162/pres.1997.6.6.603.
- Steuer, J. 1992. "Defining Virtual Reality: Dimensions determining Telepresence." *Communication* 42 (2): 73–93.
- Tamborini, R., and P. Skalski. 2006. "The Role of Presence in the Experience of Electronic Games." In *Playing Video Games: Motives, Responses, and Consequences*, edited by P. Vorderer and J. Bryant, 225–240. Mahwah, NJ, US: Erlbaum.
- Tambunan, H., M. Silitonga, and U. B. Sidabutar. 2021. "Blended Learning in Teaching Technical Teacher Candidates with Various Types of Learning Styles." *International Journal of Mobile and Blended Learning (IJMBL)* 13 (3): 58–70. doi:10.4018/IJMBL.2021070104.
- Thompson, T. L., and C. J. MacDonald. 2005. "Community Building, Emergent Design and Expecting the Unexpected: Creating a Quality eLearning Experience." *The Internet and Higher Education* 8 (3): 233–249. doi:10.1016/j.iheduc.2005.06.004.
- Tilo, H. W. Werner, V. Peter K. Christoph S. Holger, B. Saskia . 2015. "Spatial Presence Theory: State of the Art and Challenges Ahead." In *Immersed in Media: Telepresence Theory, Measurement & Technology*, edited by M. Lombard, et al., 115–135. London: Springer International Publishing: Cham.
- van Dooren, E. J. G. C., J. van Merriënboer, H. P. A. Boshuizen, M. van Dorst, M. F. Asselbergs . 2018. "Architectural Design Education: In Varietate Unitas." *International Journal of Technology and Design Education* 28 (2): 431–449. doi:10.1007/s10798-017-9396-1.
- Weibel, D., J. Schmutz, O. Pahud, B. and Wissmath . 2015. "Measuring Spatial Presence: Introducing and Validating the Pictorial Presence SAM." *Presence: Teleoperators and Virtual Environments* 24 (1): 44–61. doi:10.1162/PRES_a_00214.
- Whittle, C., T. Sonia, Y. Shulong, W. Jeff . 2020. *Emergency Remote Teaching Environment: Aconceptual Framework for Responsive Online Teaching in Crises*. Bingley, West Yorkshire, England: Emerald Publishing Limited.
- Wirth, W., M. Hofer, and H. Schramm. 2012. "The Role of Emotional Involvement and Trait Absorption in the Formation of Spatial Presence." *Media Psychology* 15 (1): 19–43. doi:10.1080/15213269.2011.648536.