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# Digital Adaptation and Perceptions of Architecture and Interior Design Students on Online Lecture Methods

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**ABSTRACT**

The COVID-19 pandemic has transformed educational practices globally, compelling a shift from traditional in-person learning to online modalities. This shift significantly impacted Architecture and Interior Design studio courses, which traditionally rely on hands-on, collaborative studio environments. This qualitative descriptive study explored the challenges faced by students during the transition to online studio-based learning. Data were collected via questionnaires distributed to Architecture and Interior Design students to examine their experiences and adaptation processes. Findings revealed that students encountered both virtual/digital and physical/non-physical obstacles. Digital limitations included inadequate access to technological devices and varying levels of digital literacy among students and lecturers. Physical challenges involved the lack of appropriate equipment and working environments at home. Additionally, students faced non-physical barriers such as changes in time management, learning methodologies, behavioral adjustments, psychological stress, and unstable internet connectivity. The transition to online studio learning involved more than technological adaptation. Effective learning outcomes were influenced by the availability of physical tools and the ability to adjust to new learning rhythms and psychological demands. These findings highlight the need for comprehensive strategies that address not only digital readiness but also physical infrastructure and student well-being. Further research is recommended to explore in depth the behavioral and psychological dimensions of this transition..



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## 1. INTRODUCTION

The COVID-19 pandemic has brought about unprecedented shifts in various sectors, including education. Among the most significant changes is the abrupt transition from traditional, in-person learning to online and digitally mediated learning environments (Cucinotta & Vanelli, 2020). For disciplines that heavily rely on hands-on, studio-based interactions—such as Architecture and Interior Design—this transition has posed substantial pedagogical and technical challenges. These studio courses,

which emphasize iterative design processes, visual communication, and real-time feedback, are traditionally conducted in physical spaces where both instructors and students interact directly using manual drawings, physical models, and immediate critiques.

With the onset of the pandemic, the educational landscape was forced to adopt online learning platforms almost overnight. Architecture and Interior Design students, especially those engaged in drawing and design studios, suddenly found themselves required to adapt not only to remote communication but also to digital media tools that support the design process. These include computer-aided design (CAD), 3D modeling software, virtual collaboration tools, and other specialized applications that necessitate a certain level of digital fluency (Andiyan et al., 2021). Consequently, students are no longer only expected to demonstrate design competency through manual drawing skills but must also master a range of digital technologies to effectively communicate their ideas in virtual environments.

This shift, however, has not been without complications. The move from physical to virtual studios has highlighted disparities in digital access and technological preparedness among students and instructors. Not all individuals involved in the learning process possess equal access to digital infrastructure, such as high-performance computers, drawing tablets, or stable internet connections (Rumaksari, 2021). In many cases, the lack of proper equipment has hindered both participation and the quality of learning outcomes. These material deficiencies have made communication between students and lecturers less effective, particularly in design critiques or feedback sessions, which are central to studio-based education.

Moreover, the digital environment inherently alters the nature of communication. While in-person design discussions allow for spontaneous interaction, the ability to annotate physical drawings, and the interpretation of body language, online communication often lacks these dimensions. As a result, important nuances in design feedback can be lost or misinterpreted, leading to divergent perceptions between students and instructors (Hatmo, 2021). In such cases, the clarity of instruction and intent may suffer, impacting the iterative process crucial for design development.

Another critical aspect to consider is the diversity of students' responses to these changes. Architecture and Interior Design students bring varied experiences and competencies into the digital learning space. Individual perceptions of the online learning method differ, shaped by a range of factors such as geographic location, digital literacy, access to devices and reliable networks, and prior experience with relevant software (Aji, 2020). For instance, students residing in remote or underdeveloped regions may face greater obstacles due to poor internet infrastructure, while others from urban centers may adapt more readily owing to better connectivity and resources.

Additionally, students' psychological readiness and motivation levels also influence their perceptions and performance in the online studio setting. The absence of peer interaction, isolation, and increased screen time have contributed to decreased motivation and engagement among many students (Siahaan, 2020). These challenges are compounded by the cognitive load of managing complex design tasks without real-time support, making learning more strenuous and potentially less effective.

Perceptions of digital studio learning also vary depending on students' familiarity with and attitudes toward technology. Some students view the online learning environment as an opportunity to develop new digital competencies that align with contemporary design practices, while others perceive it as a hindrance to their learning process due to the steep learning curve involved in mastering new tools (Budiyanto, Sudibyo, & Qosyim, 2019). Thus, students' adaptability and resilience become crucial determinants in their ability to benefit from the digital transition.

It is important to note that these issues are not limited to students alone. Instructors are also challenged to redesign their teaching strategies to suit the online format, often without sufficient training or institutional support. Many instructors may find it difficult to provide personalized feedback or maintain the same level of engagement with students through digital platforms (Karwati, 2014). This lack of pedagogical readiness, combined with technological constraints, further widens the gap between intended learning outcomes and actual student performance.

Given these complexities, it becomes essential to investigate and understand how Architecture and Interior Design students perceive and respond to online studio learning. Understanding the diversity of experiences and challenges can inform the development of more effective, inclusive, and supportive online pedagogies tailored to the specific needs of design education.

## 2. METHODS

This study explores the experiences of students with online lecture delivery and their perceptions of digital adaptation within the context of architectural and interior design education. The shift to digital learning environments, particularly accelerated by the COVID-19 pandemic, has prompted an urgent need to understand how students interact with, adapt to, and evaluate these online platforms. This research aims to provide a deeper understanding of the digital learning process from the learners' perspective, especially in practice-oriented academic disciplines.

A qualitative research design was employed to examine the lived experiences and perspectives of students engaged in online learning. Qualitative research is well-suited to uncovering complex social phenomena and subjective viewpoints, offering nuanced insights that are often not accessible through quantitative methods. This approach allows for a rich, contextualized exploration of students' attitudes, behaviors, and challenges related to online education.

The study utilized a descriptive and interpretive research approach to examine the conditions surrounding digital learning in real-world settings. The main objective of the data collection process was to gather detailed and comprehensive information that reflects the multifaceted experiences of students. Emphasis was placed on depth and context, enabling a holistic view of the digital adaptation process within design education. This aligns with the interpretivist paradigm, which seeks to understand meaning from the perspective of the participants themselves.

To collect data, both primary and secondary sources were employed. Primary data were gathered through a structured Google Forms survey distributed to students. The survey included both closed-ended questions, which provided structured information, and open-ended questions, which allowed participants to express their thoughts freely based on personal experiences. These responses offered valuable insights into the effectiveness, limitations, and emotional dimensions of online learning. In addition, secondary data were drawn from existing academic literature, institutional documentation, and relevant reports that contextualized the challenges and adaptations associated with remote learning. Triangulating these sources enriched the data set and enhanced the credibility of the findings.

The research was conducted at 11 higher education institutions that implemented the PJJ (*Pembelajaran Jarak Jauh*) system—a form of asynchronous distance learning. These universities allowed instructors to adopt various digital teaching strategies tailored to the specific needs of their courses. The data collection spanned one academic year, providing students with ample opportunity to engage with online learning environments and reflect on their experiences.

The study's population consisted of students enrolled in Architecture and Interior Design programs at the 11 selected universities. These students, from the academic cohorts of 2015 through 2021, completed design studio coursework through digital learning platforms, making them highly relevant for the investigation. A purposive sample of 121 students was selected from this population. The sample represented a diverse range of academic years and backgrounds, ensuring a broad and representative insight into the student experience. The selection was aimed at capturing recurring patterns and individual perspectives to generate meaningful and generalizable qualitative findings.

Once the data were collected, they were systematically organized and analyzed using thematic analysis. Student responses from the survey were coded to identify key themes, recurring issues, and meaningful patterns. The analysis focused on challenges faced by students, strategies for digital adaptation, and suggestions for improving online design education. By interpreting these themes, the study aimed to contribute to the development of more effective and empathetic online teaching strategies tailored to creative disciplines.

## 3. FINDINGS AND DISCUSSION

The implementation of online learning in the observed institutions is conducted through both synchronous and asynchronous methods, utilizing various web-based platforms and digital learning applications. Synchronous sessions are facilitated through video conferencing tools such as Zoom and Google Meet, allowing real-time interaction between lecturers and students. These live sessions support immediate feedback, collaborative discussions, and a sense of classroom presence despite physical separation. In contrast, asynchronous learning is primarily carried out through platforms such as Google Classroom, enabling students to access materials, submit assignments, and participate in discussions at their own pace (Cardiah et al., 2019). This dual approach accommodates diverse learning styles and schedules, promoting flexibility while maintaining instructional continuity.

In a separate observation unrelated to online learning, spatial organization during communal prayer was also noted. The limited use of prayer mats, restricted to the first two rows, suggests that congregants are still bringing their own mats from home—a behavior likely influenced by ongoing health precautions. Furthermore, the arrangement of prayer rows remains symmetrical, reflecting a continued adherence to spatial order and traditional layout practices (Cardiah et al., 2021).

### *3.1 Pandemic Influence on Lectures*

The implementation of social distancing measures has significantly influenced university lecture practices worldwide. In response to the COVID-19 pandemic, the World Health Organization (WHO) recommended avoiding close-contact activities, including peer-to-peer learning, due to the heightened risk of virus transmission. As a result, approximately 91 percent of the global student population was affected by the temporary closure of educational institutions across numerous countries (Pragholapati, 2020). Despite these challenges, the Indonesian Ministry of Education and Culture continued to support the continuation of teaching and learning activities. This commitment was formalized in Circular Letter No. 4 of 2020, issued on March 24, which emphasized the importance of sustaining education through alternative and flexible learning methods (Hatmo, 2021).

To ensure the uninterrupted delivery of educational content, lecturers were encouraged to adopt technology-based instructional strategies. These methods are designed not only to support learning continuity but also to foster interactive and engaging communication between instructors and students (Rumaksari, 2021). Online learning was implemented through both synchronous and asynchronous modes, facilitated by digital platforms and educational software. Synchronous learning involved live video conferencing sessions using tools such as Zoom and Google Meet, enabling real-time interaction and immediate feedback. Meanwhile, asynchronous learning was primarily conducted via platforms like Google Classroom, allowing students to access course materials, submit assignments, and participate in discussions at their own pace (Cardiah et al., 2019).

In a separate observation concerning public religious practices during the pandemic, spatial modifications in communal prayer settings were noted. For example, the use of prayer mats was limited to the first two rows, suggesting that worshippers continued to bring their own mats from home as a precautionary measure. Additionally, the layout of prayer rows remained symmetrical, reflecting adherence to traditional spatial arrangements despite health-related adjustments (Cardiah et al., 2021).

### *3.2 Digital Adaptation*

The COVID-19 virus, which originated in Wuhan, Hubei Province, China, rapidly spread across the globe, prompting the World Health Organization (WHO) to declare it a global pandemic (Cucinotta & Vanelli, 2020). In response to the escalating health crisis, self-quarantine and physical distancing became essential strategies to limit the transmission of the virus. These measures, while necessary for public health, have significantly disrupted various aspects of daily life, including education, commerce, and social interaction.

As the pandemic persisted, it became evident that traditional face-to-face human activities were no longer feasible in many contexts. This abrupt shift necessitated the adoption of digital technologies as the primary medium for communication, learning, and work. Educational institutions, in particular, were compelled to transition to remote learning environments, relying heavily on digital platforms and communication tools. Applications such as WhatsApp, Zoom, and Google Meet became essential for facilitating academic and professional continuity. Consequently, the pandemic has not only altered the format of educational delivery but has also accelerated the global shift toward digitalization, requiring individuals and institutions to adapt quickly to this new mode of interaction.

### *3.3 Virtual Communication*

Communication plays a fundamental role in shaping human relationships by ensuring that messages are conveyed and understood effectively (Djamarah, 2004). In the context of group dynamics, the structure of communication significantly influences how information is shared, interpreted, and acted upon. Tubbs (n.d.) identifies five distinct communication network patterns that illustrate the various ways individuals interact within a group setting.

One such pattern is the *wheel interaction*, where communication is centralized around a single prominent individual, typically the leader. In this structure, the leader occupies the central position and acts as the main conduit for all group communication. While this pattern allows the leader to maintain direct contact with each member, the members themselves cannot communicate directly with one another, making the leader indispensable for message relay.

Another common structure is the *chain interaction* pattern, where communication flows in a linear sequence, typically among three or more individuals. This model reflects a clear, unbroken line of authority or command, but limits flexibility and immediate access to information for members who are not adjacent in the chain.

The *Y-pattern* is structurally similar to the chain network but introduces a central figure within the chain who occupies a branching position. While this central member plays an important role in the distribution of information, they are still constrained by the linear flow of communication and cannot interact freely with all participants.

In contrast, the *circle communication* model promotes a more dynamic exchange of ideas. In this structure, each member can communicate with the individuals adjacent to them, creating a loop that supports more democratic participation and shared decision-making. Although it encourages interaction, the flow of information may still be slower due to the sequential nature of the communication path.

The most open and participatory structure is the *all-channel communication network*, which allows all members to communicate freely with one another. This model eliminates hierarchical barriers and promotes transparency and rapid information exchange, making it ideal for collaborative environments that require collective input and responsiveness.

These communication patterns reflect varying degrees of centralization and accessibility, each with implications for group efficiency, leadership dynamics, and decision-making processes. Understanding these models is crucial for evaluating how communication functions within educational, organizational, and digital learning settings, particularly during times of crisis when remote communication becomes the norm.

### *3.4 Non-Traditional Educational Tools*

In the current educational landscape, all forms of communication have shifted to digital platforms, relying heavily on computers and other electronic devices. Virtual learning has become the primary solution to the communication barriers posed by the closure of physical classrooms. However, the reliance on digital communication is not without challenges. Technical issues, particularly signal interference, can significantly hinder the learning experience. This is especially evident in remote or underdeveloped areas, commonly referred to as the 3T regions (*terdepan*, *terluar*, *tertinggal*—frontier,

outermost, and underdeveloped), as well as in densely populated urban zones where network congestion may occur.

Despite these obstacles, educators have adopted various strategies to ensure effective learning continues. One key approach is the integration of multiple software tools into a unified lesson plan. By combining platforms for video conferencing, assignment submission, interactive activities, and communication, teachers can create a more engaging and accessible virtual classroom environment. This integration not only supports diverse learning needs but also helps mitigate the limitations imposed by technological disruptions, ensuring that students remain connected and involved in the learning process.

### *3.5 Design and Conceptualization Tool for the Web*

Architecture students are required to engage deeply with the processes of planning and design, which are inherently collaborative in nature (Maharika & Indonesia, 2021). To enhance learning outcomes, students and instructors must work together through various forms of digital media and internet-based communication tools. This shift reflects a broader paradigm change in education, where the traditional view of the instructor as the sole source of knowledge is being replaced by a more interactive, student-centered model. In collaborative learning environments, students are encouraged to take an active role in the learning process, engaging in dialogue, sharing perspectives, and co-constructing knowledge with both peers and instructors. Learning within such courses typically follows a structured series of stages, each designed to support the development of both individual understanding and group collaboration.


**Figure 1** Phases of the design process

Studio courses in architectural and interior design education, even when conducted online, continue to follow the same fundamental design process and phases as their traditional, in-person counterparts. Each student is guided individually through these stages, with the design drawing process forming the core of studio-based learning. To replicate the hands-on, interactive nature of studio courses in an online environment, platforms such as Google Meet and Zoom are used to facilitate communication between students and instructors. However, this virtual adaptation requires the integration of specific digital tools and media to effectively convey design concepts and provide feedback.

In a typical offline setting, studio courses are assigned between three to five Semester Credit Units (SKS), as defined by the Indonesian Ministry of Education and Culture (Kementerian Pendidikan dan Kebudayaan, 2014). One SKS corresponds to approximately 160 minutes of academic engagement per week, comprising 50 minutes of direct interaction (face-to-face), 50 minutes of structured assignments, and 60 minutes of independent learning. For a five-credit studio course, this equates to 250 minutes of weekly face-to-face time—about four hours and ten minutes. These structured learning principles align with national higher education standards as outlined in Permenristekdikti No. 44 of 2015.

The shift to online learning during the pandemic has presented significant challenges to maintaining these standards. Online interactions, despite their advantages, cannot fully replicate the richness and immediacy of face-to-face engagement. Monitoring student progress in real-time and ensuring comprehension becomes more difficult in the absence of physical classroom dynamics. Nonetheless, studio courses remain essential due to their problem-solving orientation, which encourages students to address real-world design challenges through a practical, iterative process

(Primadewi et al., 2021).

Architectural practice traditionally involves three primary stages: conceptualization, design development, and construction (Devins et al., 1990; Primadewi et al., 2021). Originally rooted in workshop-based instruction, the studio model has transitioned into an e-learning format that delivers these stages through digital platforms. This transition brings both positive and negative implications. On the positive side, digital tools streamline communication between students and lecturers, while cloud-based storage provides accessible, real-time access to information and course materials. These advantages support a more dynamic, flexible learning environment.

However, several drawbacks have also been observed. Instructors and students may overlook essential information shared via digital media, often due to platform unfamiliarity or communication breakdowns. Technical limitations, such as unstable internet connections, and varying levels of digital literacy among both students and lecturers further hinder the effectiveness of online studio learning. In some cases, the intent behind instructional material is lost in translation, leading to misunderstandings and reduced learning outcomes.

Particularly for first- and second-year students, the transition to online studio learning poses significant challenges. Many struggle to grasp fundamental concepts such as scale, proportion, and spatial relationships when working digitally (Dini & Syamsiah, 2021). Limitations in site analysis are also apparent, as students are unable to visit or experience physical locations directly. Some rely on intuition rather than rigorous analytical approaches, assuming that digital imagery alone is sufficient to understand site-specific conditions, which can result in superficial design solutions.

Additionally, the open accessibility of design content on the internet has impacted students' originality and creativity. In some cases, students replicate online sources rather than developing their own ideas, which diminishes the creative value of their work. Effective studio learning requires emotional investment from students—an element that is often harder to cultivate in an online environment. As Purwantiasning and Djuha (2016) noted, the design process is not only technical but also deeply emotional; students who are both digitally literate and emotionally engaged tend to produce stronger, more character-driven designs.

The global transition to digital learning marks a significant cultural shift for students. Rapid technological development has disrupted traditional academic and social structures, resulting in what Piliang (1998) describes as social transparency—a condition in which established moral and hierarchical boundaries are blurred within the virtual space. This transformation allows individuals to engage freely in digital environments, often adopting alternate personas in the process. During the pandemic, many universities rapidly adopted online lecture models, adjusting institutional policies to accommodate remote learning. This study gathered data from students and institutions involved in interior architecture and design programs, illustrating how this digital adaptation unfolded during a period of crisis.

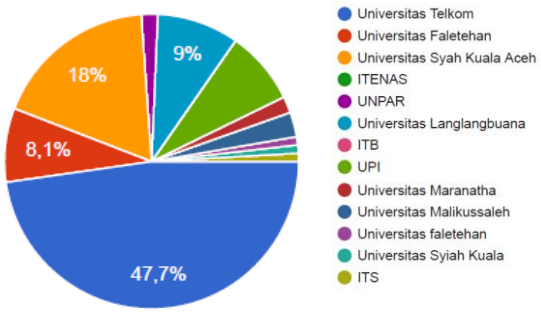


**Figure 2.** Institutional Backgrounds of Respondents

The effectiveness of online education in architecture and interior design can be observed through the use of virtual communication, which enables students to remain connected and engaged in

academic activities. Virtual platforms provide a space for continuous interaction, collaboration, and feedback—essential components in design-based learning. According to Reigeluth (1989), successful learning is defined by several key characteristics: it is active, complex, and tailored to individual learners and their specific learning environments. Additionally, efficient learning is marked by accurate comprehension of content, quick application, high levels of knowledge transfer, and strong retention over time. These principles are crucial when evaluating the effectiveness of online learning systems. Figure 2 illustrates the distribution of student levels surveyed in this study, highlighting the comprehensive scope of the data collection process and demonstrating the success in reaching diverse groups of learners.

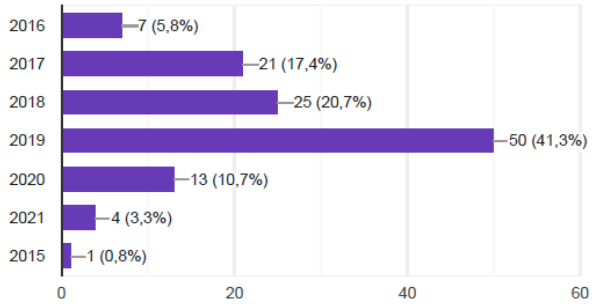


**Figure 3** Getting Ready to Start College

A well-developed education system is often a strong indicator of a nation's overall development. One of the globally recognized tools for evaluating educational quality is the Programme for International Student Assessment (PISA), which collects and analyzes data from the education sectors of participating countries to assess the effectiveness of their systems. In efforts to improve educational outcomes, the integration of information technology has become a key strategic approach (Warsihna & Warsihna, 2016). Technologies such as e-books, online learning platforms, and other digital tools are increasingly being adopted to support teaching and learning processes. E-learning, in particular, has shown potential in enhancing students' scientific literacy and promoting more consistent, self-directed study habits (Budiyanto et al., 2019; Elyas, 2018). By leveraging these digital resources, educational institutions can foster more accessible and effective learning environments.

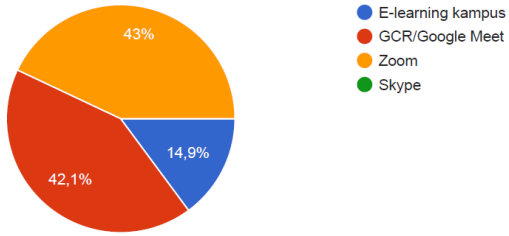


**Figure 4.** A Learning Management System

The term *media* encompasses both textual and audio-visual forms of communication, as well as the tools and technologies used to deliver them. Derived from the Latin word *medium*, meaning "between," media serve as intermediaries that transmit information from the source to the recipient. In educational contexts, media are understood as any means that facilitate the communication of knowledge and support the learning process. According to Arief (2009), Briggs defined media as any element that assists students in acquiring knowledge, whether through visual, auditory, or interactive formats. In this study, data were collected through student surveys conducted both online and offline, as illustrated in Figure 4.

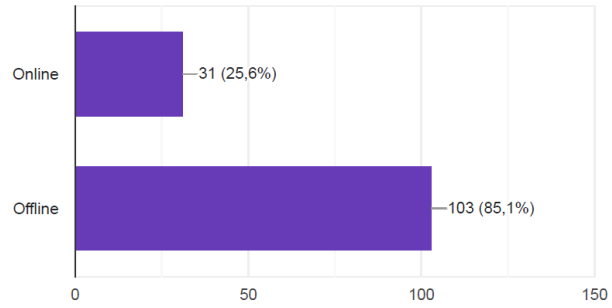


**Figure 5.** Student Perceptions of an Enjoyable Studio Learning Experience

Learning media play a critical role in the educational process, as lecturers are increasingly required to possess a functional understanding of relevant technologies. Teaching and learning, or *Kegiatan Belajar Mengajar* (KBM), is fundamentally a two-way communication process in which media serve as the intermediary between the instructor (message sender) and the student (message receiver). These tools facilitate the delivery of content, ideas, and information, thereby enhancing the overall learning experience (Arief, 2009). As illustrated in Figure 5, the survey results reveal several challenges associated with online learning—challenges that are unsurprising given the technical complexities involved in digital education environments.

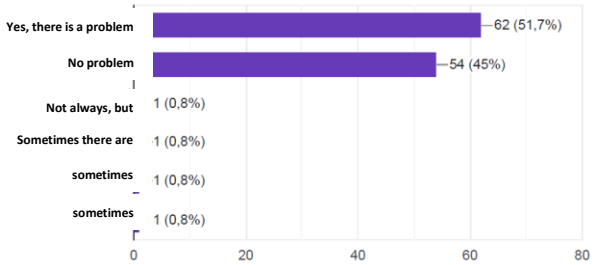


**Figure 6.** The e-learning platform has restrictions on its usage

To support students in navigating the social challenges of online learning—particularly those that impact family dynamics—it is important to consider the broader consequences of the digital learning shift (Dulkiah et al., 2020). The COVID-19 pandemic has significantly disrupted the education sector, as many educational institutions were forced to suspend in-person operations, at least temporarily (Aji, 2020). This disruption affected the continuity of instructional programs and altered the dynamics of student-teacher interactions, leading to increased stress for parents and a noticeable decline in students' academic performance and engagement.

Prior to the pandemic, research by Karwati (2014) already indicated clear differences in learning outcomes between face-to-face and distance learning environments. These findings underscore the unique challenges that studio-based courses, in particular, face when adapted to an online format. Studio learning, which traditionally relies on hands-on interaction, real-time feedback, and spatial engagement, must address significant pedagogical and technological obstacles to ensure effective administration and meaningful student learning in virtual settings.

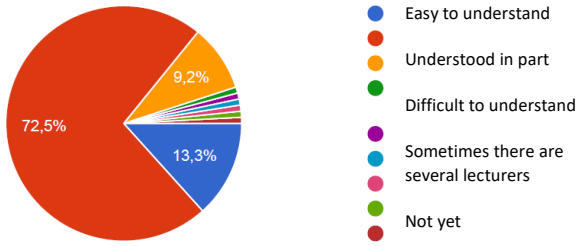


**Figure 7.** How Studio classes are interpreted by students

Professors have faced a range of challenges in adapting to online teaching environments during the COVID-19 pandemic (Siahaan, 2020). One significant obstacle is the limited access to reliable internet connections and the inadequate availability of digital devices, which hinders both the delivery of instruction and student participation. In addition, prolonged exposure to online learning environments has led to increased levels of boredom and disengagement among students (Pawicara & Conilie, 2020). For instructors teaching studio-based courses, the lack of diversity in instructional methods has further complicated the learning process, making it difficult for students to fully understand and complete their assignments. Moreover, insufficient variation in teaching strategies can reduce the effectiveness of remote learning, particularly in courses that depend on active, hands-on engagement. Compounding these academic challenges are broader financial implications, such as institutional losses incurred from project delays—highlighting the importance of timely adaptation and the potential cost savings that could be achieved through more efficient implementation strategies (Andiyan et al., 2021).

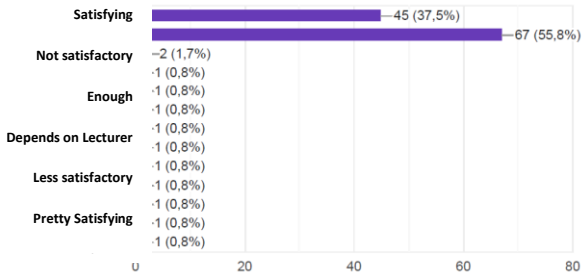


**Figure 8.** Support Provided in Online Studio Assignments

Aside from too many duties, too few study partners owing to distance learning, a lack of focus due to looking at a phone or laptop screen for too long, a time constraint and an unsupportive family environment, boredom might result.

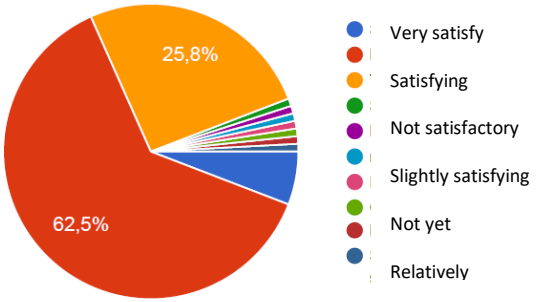


**Figure 9.** What you may expect from the tasks you do in Online Studio

As previously noted by Sari and Mayrita (2020), the effectiveness of online learning often depends on the instructor's ability to utilize widely used digital platforms to support their teaching. Beyond simply employing various forms of media, it is also crucial to incorporate a range of task types to maintain student engagement and enhance learning outcomes. This aligns with the findings of Intan et al. (2021), who emphasize the importance of thoughtfully designing online learning strategies. Educators must be intentional in selecting appropriate instructional media and methods to ensure that the learning experience is both effective and pedagogically sound.

## 4. CONCLUSION

This study concludes that the shift to online learning during the COVID-19 pandemic has had a significant impact on students, instructors, and parents alike, particularly within architecture and interior design education. Internet connectivity issues and limitations in digital teaching infrastructure have contributed to a general decline in student motivation and engagement. Data collected via Google Forms revealed that while some students accepted e-learning as an alternative learning method—evident in 47.7% of respondents from campus environments and 41.3% among early-year students from the 2019 cohort—many faced challenges. For example, while 43% reported using Zoom as their primary platform, and the lecture system received an 85.1% satisfaction rating in the offline category, issues related to platform constraints scored an average of 51.7%, falling into the obstacle category. Additionally, only 72.5% of students reported a partial understanding of studio courses delivered online, with the quality of instructional support rated as unsatisfactory (55.8%) and the outcome of studio assignments deemed only satisfactory (62.5%). These findings suggest that while e-learning platforms have potential, their effectiveness is influenced by perceived usefulness, platform complexity, and students' available time. However, a key limitation of this research lies in its reliance on self-reported survey data, which may be influenced by respondent bias or limited contextual detail. Furthermore, the sample is restricted to a specific academic discipline, which may limit generalizability. Future research should explore cross-disciplinary comparisons, include qualitative insights through interviews or focus groups, and evaluate user interface design and usability of synchronous platforms such as Google Meet and Zoom to improve student engagement and instructional quality in virtual learning environments.

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