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Empowering Architectural Design Education Through Cloud-Based Systems in Online Learning

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ABSTRACT
This study investigates the integration of cloud-based systems in architectural design education, with a particular focus on the "Introduction to Architectural Design" course in the context of online learning. Utilizing real-world examples, student surveys, and a comprehensive literature review, the research identifies a specific gap concerning the use of cloud drive systems in architectural design studio education. The methodology includes the unique context of an earthquake, after which all universities were directed to transition to online learning by the central government, and the Coordinator's prior experience with online architectural education at the Covid-19 era. Findings reveal positive trends and minor technical concerns in the application of cloud computing in architectural design instruction. The discussion and conclusion emphasize the profound effect of cloud drive systems on architectural design teaching, revealing an exciting frontier with both opportunities and challenges. The study contributes valuable insights for future implementations and research, aligning with broader educational trends and underscoring the need for collaboration among various stakeholders.
Keywords: Cloud-based systems, architectural design education, online learning, technology integration.

1. INTRODUCTION

Especially in fields that rely heavily on digital tools and collaborative environments, the incorporation of technology into education has become a defining feature of modern pedagogical practices. Architectural design education is at the forefront of this shift because of the complexity and diversity of the field itself. Given the specific requirements and possibilities of cloud systems, investigating their use in architectural design education is an important area of study.

Educating future architects is a dynamic field that calls for a fine equilibrium of artistic vision, technical mastery, teamwork, and critical thinking. Challenges and opportunities are emerging as a result of the shift toward online learning, which has been accelerated by worldwide catastrophes and technological advancements. Among these, cloud-based systems have emerged as a potentially fruitful avenue for improving the design submission process, facilitating real-time feedback and enabling distance learning.

In the field of architectural design, it is crucial to investigate cloud systems as an alternative to conventional online learning platforms. Regular platforms may stick to traditional two-dimensional presentations, while cloud systems offer novel ways to present work in original software and enable deeper critiques. Informed pedagogical practices require an appreciation of the effects, advantages, and disadvantages of such systems.

The Aim of the study is to investigate the use of online learning platforms and cloud-based systems in the field of architectural design instruction. Focusing on the "Introduction to Architectural Design" course taught in the second semester of the first year of the graduate program, this research examines the use of cloud-based systems and traditional online learning platforms in the context of architectural design education.

The use of cloud-based systems in contemporary architectural design education has brought both benefits and difficulties. In the context of the graduate program's "Introduction to Architectural Design" course, these systems are crucial to improving the quality of instruction. Students and professors can work together in real-time using cloud-based systems. Students can share their design projects with one another and their teachers through the cloud. The design review process is made more versatile and convenient as files can be uploaded and accessed from multiple devices.

There are many benefits to using cloud-based systems, but there are also some difficulties to be aware of. A potential concern is whether or not all students have access to the cloud system and whether or not their files are compatible with each other's devices. Implementing cloud-based systems may call for technical support and present a learning curve; data security and privacy worries must also be addressed.

2. LITERATURE REVIEW

2.1. The Use of Cloud Storage for Virtual Classrooms

Researchers and professors alike have been considering how best to use cloud drive technology in online education (Hamidah & Prystiananta, 2022; Shahhosseini et al., 2022; Spirin et al., 2022; L. Wang et al., 2022). Pre-pandemic researches show that using cloud-based file sharing systems improves accessibility and collaboration in the classroom (Al-Zoube, 2009) in various fields as medical (Doherty et al., 2015), engineering (Erturk, 2016; Marra et al., 2016) or philology (Komissarova et al., 2017). A major shift from traditional correspondence-based courses to virtual learning environments has occurred in the field of distance education in the wake of the COVID-19 pandemic (Alqahtani, 2022; Kurniawansyah & Siswanto, 2020; Pregowska et al., 2021; Xu et al., 2022). For some fields, like architectural design, where teaching strategies are constantly evolving, this transition has been especially difficult.

2.2. Online Learning in the Field of Architecture

Integration of cloud-based systems is discussed, with a critical eye on the concept of software liberty. In architectural education, students' freedom of expression and exploration can be constrained by the use of proprietary software. This factor emphasizes the significance of striking a harmony among pedagogical goals, student agency, and technological incorporation in the classroom (Schnabel & Ham, 2014).

The use of cloud-based systems in online education has been investigated in a number of settings. For instance, Wong's team found that teaching construction using cloud-based Building Information Modeling (BIM) increased teamwork and productivity (Wong et al., 2014). Integration of cloud-based systems in the context of remote practice methods, such as survey education for HBIM (Historic Building Information Modelling), has been investigated in architectural education (Xi & Cong, 2022). Even with the limitations imposed by the pandemic, delivering HBIM models via virtual tours and other online methods has proven to be successful.

As a direct result of the COVID-19 pandemic, significant shifts have occurred in the architectural education system. Because of the rise of online education, new pedagogical approaches and digital platforms have been created (Milovanović et al., 2020). To combat issues like isolation and mobility restrictions brought on by pandemics, online workshops have been recognized as a novel educational opportunity. There has also been investigation into what it's like to work in a virtual architectural design studio, with studies looking at the benefits and drawbacks of this method (Ozorhon & Lekesiz, 2021). While new strategies are required for success in distance education, the experience of remote conducting with second-grade architecture students has shown that elements such as interaction, collectivism, and dynamism can survive.

2.3 Gap in the Literature

There is a noticeable lack of research focusing specifically on the usage of cloud systems in online architectural design studio education, despite the growing body of literature on cloud drive technology, integrated cloud-based systems, and architectural education in online learning. To address this gap, this paper investigates how "Introduction to Architectural Design" students can benefit from cloud drive technology in terms of increased opportunities for teamwork, convenience, and productivity during the design submission phase of the course.

The reviewed literature has given us a summary of what we know about cloud drive technology, integrated cloud-based systems, and online architectural education at the moment. This paper aims to fill a void in the existing literature by discussing the benefits of using cloud systems in the architectural design studio learning environment.

3. METHODOLOGY

3.1. Context

An enormous earthquake hit the country at the start of the semester, forcing many people to relocate and making online classes the only option for students. Due to the Coordinator of the "Introduction to Architectural Design" course's prior experience with online architectural education, this choice was made after the pandemic. This singular confluence of factors chimes with the worldwide trend toward online education and presents both difficulties and possibilities for testing out novel approaches to teaching architectural design.

An "Introduction to Architectural Design" course in the second semester of the first year of graduate school was the setting for the study. The study followed the current trend of incorporating technology into the classroom by using a mixed-methods approach. This strategy combined quantitative and qualitative findings to provide a holistic examination of the topic.

Students' perspectives on using cloud-based systems for architectural design education were solicited via a carefully crafted survey which is utilized after the grading of the semester. The method reflects the recent push to learn how students experience the use of technology in the classroom. In accordance with current directions in the field of education research (Wong et al., 2014), the survey included both linear-scale questions and open-ended text responses from students.

3.2. Number Crunching

Both statistical and thematic analyses were performed on the data collected. With this method, we were able to gain a more nuanced understanding of complex phenomena by combining numerical data with thematic insights. The methodology section presented the study's research strategy, data collection techniques, and data analysis steps. We have provided a critical understanding of the circumstances that shaped the research by emphasizing the specific context of the earthquake, the history of online education during the pandemic, and the Coordinator's personal opinions. This all-encompassing approach to research places the study within the larger academic discourse, bolstering the study's rigor and applicability as an examination of cloud-based systems in architectural design education in online settings.

4.SURVEY

Student responses to a survey administered as part of this study shed light on the potential benefits of using cloud computing in the classroom for those studying architectural design with 11 students. Both quantitative and qualitative analyses are provided to illustrate the results. The survey questions can be found at the following:

"Use of Cloud-Based Systems in the Introduction to Architectural Design Course: The first five questions of this survey are being measured for their impact on the "learning outcomes" listed in the official course catalog. When filling out the survey, remember that you did not receive critiques in 2D, but in 3D, in whichever program you are using. Mark the learning outcomes on a scale of 1-5, with 5 being the most positive and 1 being the most negative.

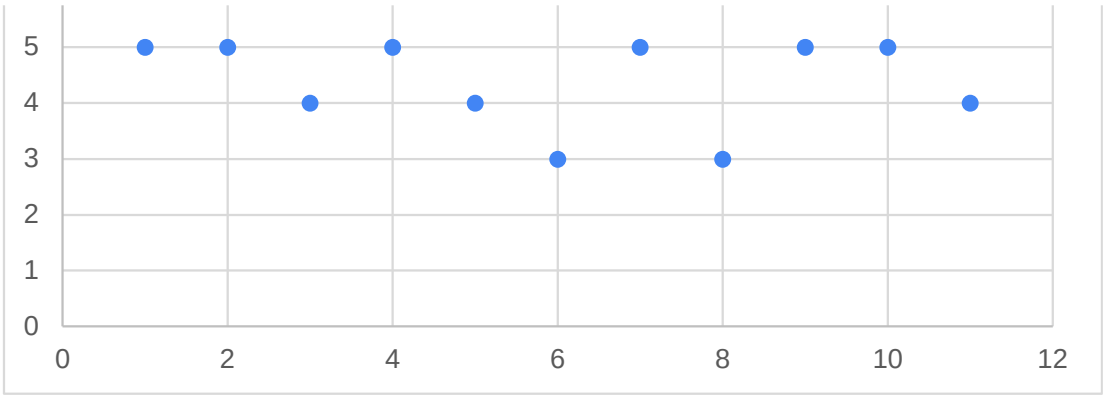
1- The effect of the cloud system on understanding the environmental, functional, formal, and structural components directed towards the architectural design problem.
2- The effect of the cloud system on grasping human, body, space relationships, and using anthropometric data in the design process.
3- The effect of the cloud system on solving form, function, and structure relationships in simple functional spaces.
4- The effect of the cloud system on designing closed, semi-open, and open volumes by establishing hierarchical relationships between spaces.
5- The effect of the cloud system on presenting the project using different communication tools (verbal, written, digital).
6- The effect of its use in online education.
7- The overall effect of the cloud system on your design process.
8- The effect of the cloud system on producing two-dimensional presentations like preparing sheets.
9- How did the cloud system POSITIVELY change the design activity in the design education process?
10- How did the cloud system NEGATIVELY change the design activity in the design education process?
11- This space is free. You can pour your thoughts here if you wish..."

It is of significance to note that 1-5 inquiries derive from the "learning outcomes" stated in the official course catalog. The grading system for questions 1-8 follows a linear scale. Questions 9 through 11 consist of open-ended textual prompts.

4.1. Quantitative Evaluation

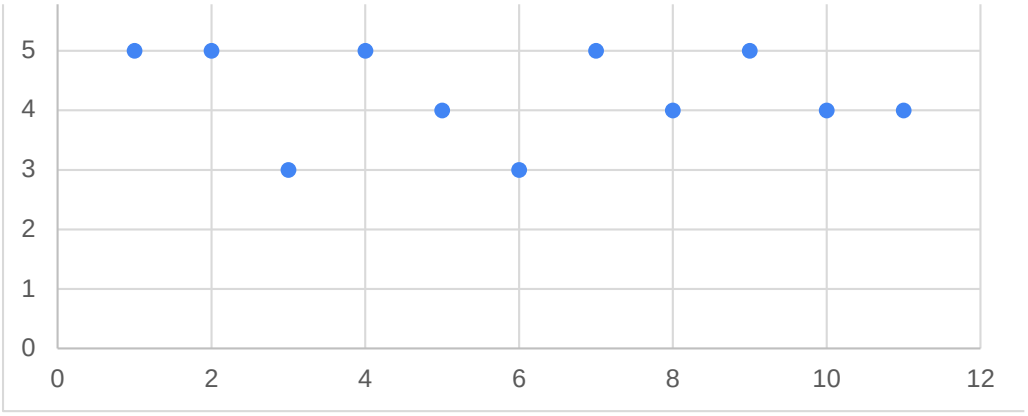
The quantitative study shows that the cloud system is very well received in the field of architectural design instruction. Here is a rundown of the most important results:
When asked how helpful they found the cloud system in understanding different aspects of design, students gave score between 3 to 5 with an avarage of 4.36.

Table 1 The effect of the cloud system on understanding the environmental, functional, formal, and structural components directed towards the architectural design problem.



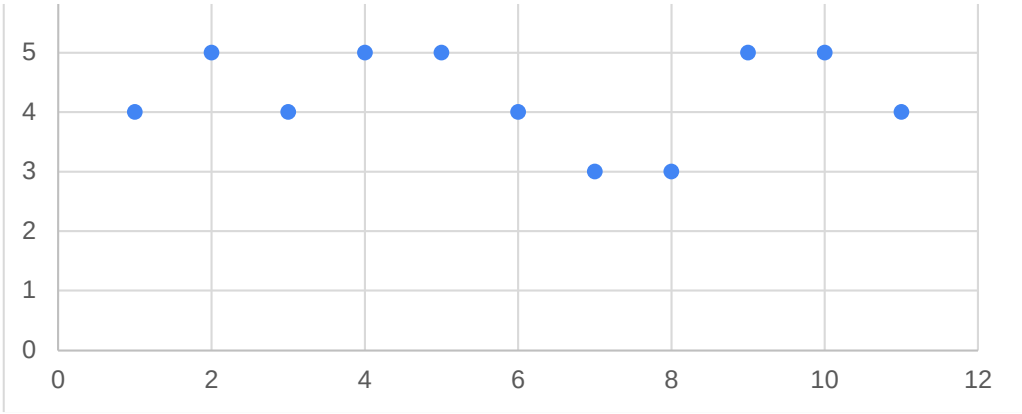
Human-Body-Space Relationships: Ratings ranged from 3 to 5, the avarage is 4.27 for its usefulness in comprehending and applying anthropometric data.

Table 2 The effect of the cloud system on grasping human, body, space relationships, and using anthropometric data in the design process.



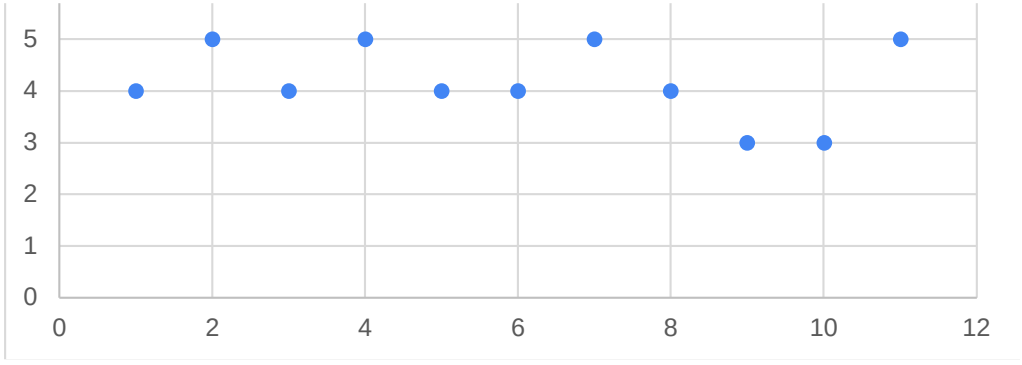
The majority of responses to a survey about the impact of form function and structure relationship in simple functional spaces avaraged 4.27 as well.

Table 3 The effect of the cloud system on solving form, function, and structure relationships in simple functional spaces.



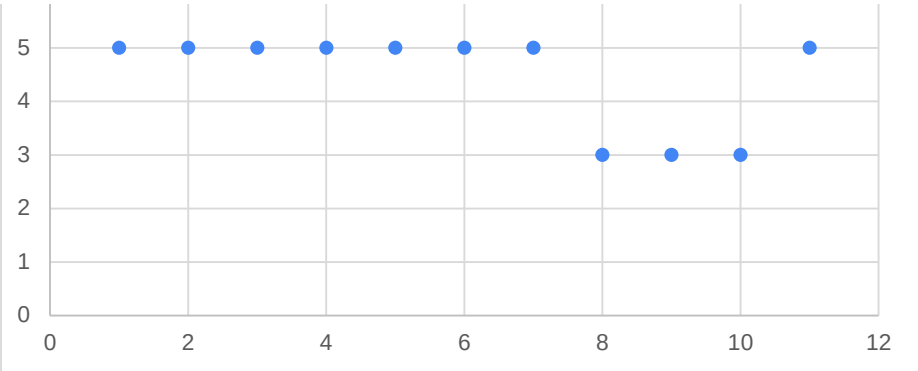
Based on the analysis of the fourth question, which explores the impact of cloud systems on the design of closed, semi-open, and open volumes through the establishment of hierarchical links between spaces, it is observed that the average grade of the responses is 4.18. Notably, this score represents the lowest among all quantitative questions.

Table 4 The effect of the cloud system on designing closed, semi-open, and open volumes by establishing hierarchical relationships between spaces.



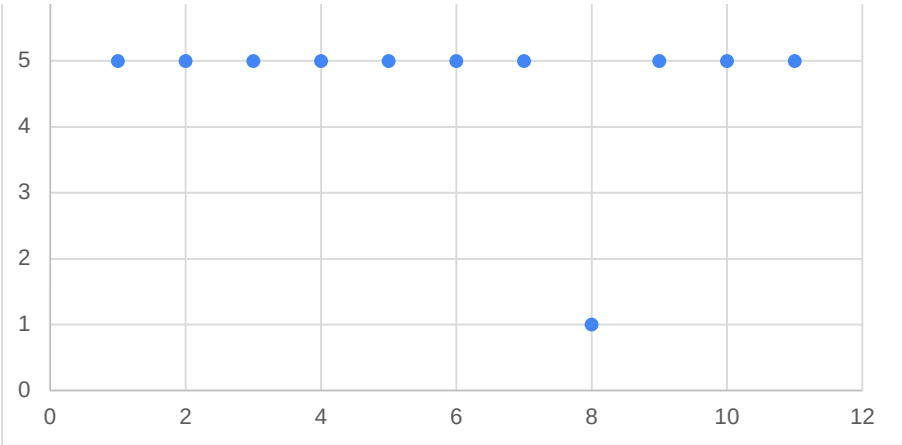
In relation to the fifth inquiry, this study examines the impact of cloud systems on the delivery of project presentations through various communication mediums, including verbal, textual, and digital formats. The mean grade of the responses is 4.45.

Table 5 The effect of the cloud system on presenting the project using different communication tools (verbal, written, digital).



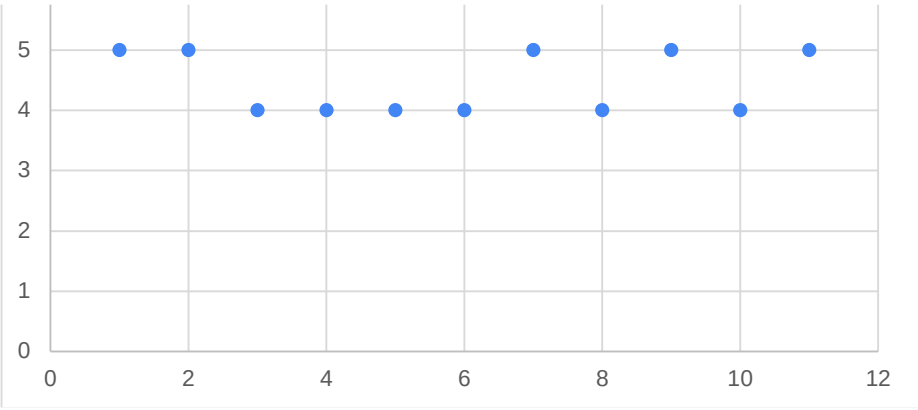
There was only one 1 out of a total of all perfect ratings for the impact on online learning during the design process with average of 4.63, which is the highest rank in all survey.

Table 6 The effect of its use in online education.



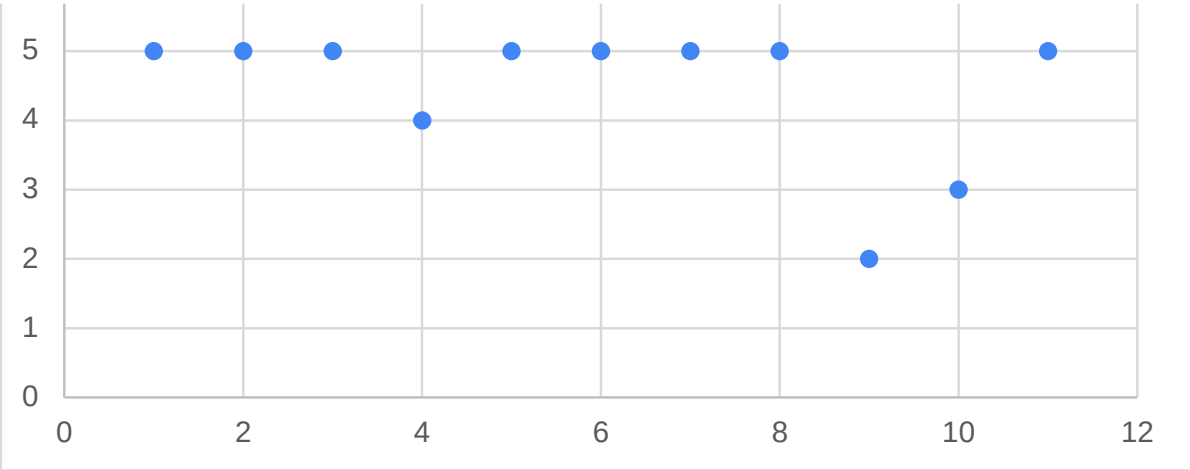
Overall Impact on the Design Process: Ratings were very positive with average of 4.54.

Table 7 The overall effect of the cloud system on your design process.



Impact on Preparing Two-Dimensional Presentations: Most responses fell in the 4- to 5-point range, indicating a generally positive experience with average of 4.45.

Table 8 The effect of the cloud system on producing two-dimensional presentations like preparing sheets.



4.2. A Qualitative Look

Textual responses from students are the basis for the qualitative analysis, which allows for a richer understanding of the students' experiences.

Positive Influences

Students enjoyed the ease of making revisions in real time, receiving feedback in an open and honest manner, and reverting back to previous drafts of their work.
Critiques and comparisons of other designs using 3D visualization were helpful.
The cloud system has been lauded for its ability to speed up the design process and improve comprehension.

Unfavorably Affects

Some students raised technical concerns, including slow upload speeds and shaky connections to the internet. Some students had trouble visualizing how their designs would function in practice and voiced worries about their ability to be creative.

Open Reflections

Students, after initially being sceptical of the online project classes, expressed gratitude for the experience and reported increased productivity as a result.

The survey results provide an in-depth look at how cloud computing has changed the architectural design classroom. Positive trends are evident in the numbers, and the qualitative analysis sheds light on the students' experiences, both good and bad. Collectively, these results shed light on how cloud systems can most profitably be incorporated into architectural design education, providing direction for future implementations and research. The empirical evidence that supports the broader arguments and themes explored in the paper is presented here, bridging the gap between the article's methodology and discussion sections.

5. DISCUSSION

In this research, we examine the promising yet complex landscape of cloud system integration in architectural design education. The results of the student survey can be used as a jumping off point for a more in-depth discussion of the integration's ramifications, potential applications, and potential future directions.

5.1. Improving the Educational Process

The survey's findings that using cloud systems improves the educational experience are consistent with industry-wide tendencies in digital training. The literature on technology-enhanced learning (Bower & Vlachopoulos, 2018; Jayashanka et al., 2022) echoes students' appreciation for the efficiency, engagement, and understanding facilitated by cloud systems. Traditional teaching methods may struggle to compete with the engaging learning environment made possible by real-time feedback, recorded criticism, and 3D design comparison.

5.2. Problems and Methods in the Field of Technology

It's not just architectural design education that faces technical hurdles like slow upload speeds and unstable internet connections. Different online learning environments have identified similar difficulties (e.g., (Dahiya et al., 2021; Lai & Widmar, 2021; R. Wang et al., 2022)). For these problems to be solved, it is essential that academic institutions, technology providers, and policymakers work together (Altindag et al., 2023; Rosenboom & Blagg, 2018).

5.3. The Power of Imagination and Creativity

A larger conversation about the trade-offs between technological ease and creative freedom is sparked by some students' worries about creativity and visualization. The literature on creativity in online education (for example, (Imottesjo & Kain, 2022) stresses the significance of creating a space that welcomes experimentation and exploration without the limitations of technology.

5.4. Earthquake and Pandemic as Contextual Factors

Additional complication is introduced by the study's contextual factors, such as the earthquake's impact on education and the previous experience with the pandemic. The educational system's flexibility and ability to bounce back from shocks like these are on full display (see, for example, (Ozorhon & Lekesiz, 2021). The knowledge gained from these incidents can be used to better prepare for sudden shifts to online education.

5.5 Looking Ahead

There is room for growth and innovation in the field of teaching architectural design with cloud-based systems. Longitudinal studies, a variety of classroom settings, and the investigation of cloud-based tools and platforms could all inform the direction of future study. The full potential of cloud systems in education cannot be realized without the combined efforts of educators, technologists, and researchers. This draws attention to how well these studies fits in with broader educational trends, discusses any problems that were encountered, and offers suggestions for how the research and practice could move forward.

The use of cloud-based resources in the classroom has the potential to improve both the teaching and learning of architectural design. The identified minor technical issues and concerns can be addressed through cooperation and ongoing improvement, making way for a more robust and adaptable instructional strategy.

7. CONCLUSION

The integration of cloud drive systems, especially in the context of online learning, has had a profound effect on the teaching of architectural design, a subject that is both multifaceted and complex. The results show that the ability to access and share files through cloud drive systems was very well received by the students. The design and submission process was simplified, and the classroom was made more engaging and interactive as a result of the two processes coming together. While some minor technical difficulties were noted, these issues highlight the need for ongoing collaboration among teachers, technologists, and students.

Aligning with movements in online education and the creative arts, this discussion places these findings within a larger body of work on the integration of technology into education. Future research and practice can benefit from this understanding of the special challenges posed by architectural education and its emphasis on interdisciplinary teams and a wide range of equipment.

In conclusion, the use of cloud drive systems in architectural design studio education is a major step forward in providing for the varied requirements of the field through distance education. It is consistent with larger movements in digital education, providing a malleable and extensible model for use in a wide range of settings. The findings of this study add to the growing body of knowledge that can direct teachers in using technology to improve student learning, especially in fields that require extensive group work and the sharing of files.

The research fills a gap in the literature by examining the use of cloud drives in online architectural design studio education, providing a nuanced understanding that can guide future implementations. The findings of this study provide a solid groundwork for future developments in education, particularly in areas that call for intricate teamwork.

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