



# **A Framework to Enhance Flexible Blended Architectural Design Education: Monitoring the Experience of Architectural Design Studios at Delta University for Science and Technology, Egypt**

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## **Abstract**

In the last few years, there have been lots of worldwide challenges such as pandemics and wars which have posed a series of encounters in architectural education for both teachers and students. This, in turn, has raised a question on the resilience of the architecture education process and its ability to adapt to the post-digital period and the future of architectural education in general. Architecture and design environments mainly require face-to-face learning techniques that depend on the interaction between the students and their teacher in both application and practical education. Studio-designed spaces provide solidarity, positive energy, and motivation for students. Therefore, activating the distance learning process affects the architectural education strategy and directs institutions and teachers to the necessity of flexibility and adaptation as an integral part of architectural education curricula.

This study employs a deductive methodology focusing on the importance of flexible architectural education through the overlap between the traditional studio and the virtual studio. It aims to achieve a positive experience for students and staff members in an attempt to evaluate the role of blended learning experiences in incorporating architectural design programs that were first applied after the last pandemic. This is done by observing a design studio procedure during a blended learning period. In addition, a questionnaire is conducted on several students and faculty members regarding the subject of architectural design at one of the Egyptian universities. It focuses on the significance of the integration of distance learning for flexible handling of architectural design education concerning the era of pandemics, the digital age, and the like. The research contributes to developing a future framework that enhances the flexibility of architectural design education, supports self-learning, and turns the architectural design studio into a dynamic studio that provides an opportunity for reproduction and renewal.

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## **Keywords**

*Architecture design education; Flexibility; Blended learning, Traditional design studios, Virtual design studio*

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## **1. Introduction**

In the early seventies, a philosopher named Donaldson introduced the idea of losing the steady state and called for the establishment of adaptive systems to ease the understanding of the situation. Nowadays, digital technologies, wars, and pandemic crises cause other effects regarding the loss of the steady state (Salama, A. 2006). Therefore,

architectural education, especially architectural design, is going through an unprecedented situation through a transitional emergency model that requires more adaptation to deal with it (Salama, A. 2006). Besides, during the last pandemic, COVID-19, and after the lockdown of most of the educational institutes and avoiding face-to-face education for health issues, the idea of blended learning, a mix of conventional face-to-face instruction with online educational tools and resources, came as a solution to pass that phase safely (Zhang, C., Wen, M., Tong, K., Chen, Z., Wen, Q., Yang, T., & Liu, Q. (2022).

Most of the educational institutes had to lock down permanently or temporarily. Although some institutions have adapted and continued, others are still facing problems using distance learning as a new concept of interaction between students and teachers in all grades (Alnusairat, S., Al Maani, D. and Al-Jokhadar, A. 2021). This led to a growing sense of chaos in the educational systems and severely hindered progress all over the world. Therefore, educational institutions had to adopt a rapid redesign of the teaching and learning systems that would enable them to get rid of the fear of epidemics, adapt to them, and prepare to deal with any similar possibilities (Pokhrel, S., & Chhetri, R. (2021). A complete or partial lockdown was imposed on the different universities, which had a great impact on education in general and architecture in particular. Generally, architects depend on practical education. Therefore, peer work, competing, transferring, and sharing ideas are essential. Hence, design studios depend mainly on face-to-face education to help form ideas, transfer experiences, and develop creativity among students of architecture (Nik Lukman Nik Ibrahim, Nangkula Utaberta, 2012).

Blended learning, a mix of both face-to-face and online education, was then introduced as an effective tool for a successful strategy in architecture education (Megahed, N. and Hassan, A. (2022). The suggested blended learning educational model integrates the assistance of both in-person and online learning settings for a more resilient, interactive, and customized learning experience. In the context of architecture education, blended learning provides special benefits such as access to a wide range of materials, the capacity to interact with complicated design tools, and the encouragement of collaborative projects among students (Singh, J., Steele, K., & Singh, L. (2021). By hosting blended learning that depends mainly on digital technologies, the students would be able to better visualize and modify their work during the educational process which includes the concept, visual simulation and example analysis, decision-making process, and receiving staff feedback on their design (Valverde-Berrocoso, J., Fernández-Sánchez, M.R. (2020). Furthermore, blended learning encourages the development of key skills such as digital literacy, critical thinking, and problem-solving, all of which are required for modern architects (Wei, Zhaoxi. (2023).

In the present study, the authors try to assess blended learning as an advanced teaching tool to fill the gap between face-to-face and online learning at Delta University for Science and Technology (DU). one of the Egyptian universities that offers a credit hour system to the architecture major in engineering. The study focuses on monitoring the sudden isolation of students from tutors in architecture design studios and the procedure that is taken to create a new intermediate educational system. This system is offered with the help of the college portal and other tools offered to the educators by the college, such as the virtual portal, which was improved over time to include organized and timed Zoom meetings to provide more lectures and design meetings.

Teaching students in virtual online studios paved the way for developing architectural design studios. Therefore, more academic communities attempted to rethink the challenges that can face online virtual studios (Duong Huu Tong, Bui Phuong Uyen, Lu Kim Ngan, 2022).

The challenges of blended learning were not just centered on the students but also on the tutors at DU. The entire academic community; especially in the architecture department, was forced to face these challenges despite the experience or tools needed to deal with the students online, such as digital literacy, high-speed internet, and advanced computers or tablets, which facilitate assignment assessment by the tutors ( Rasheed, Rasheed & Kamsin, Amirrudin & Abdullah, Nor. (2019) During the pandemic, the shift to blended learning created an opportunity for architectural schools to reimagine the learning experience where any medium could be used to deliver effective instruction. Thus, devising new ways and technologies was highly required along with the possibility of changing educators who were unable to adapt to these new challenges (Komarzyńska-Świeściak, E., Adams, B., & Thomas, L. (2021).

This research introduces the experience of changing design studios from face-to-face to virtual online design studios in the architecture department at DU. In addition, it discusses the evaluation and the outcomes of the experience

introduced during the academic year 2020-2021 for the 4th-grade architecture students (7th and 8th semester), including two design courses in a row for the same educational group in terms of culture center for one module and a mixed-use building for the other module. It highlights the pros and cons of blended learning and how to develop resilient design studios to meet any upcoming changes.

## 2. Methodology

This paper depends on a mixed-methods approach. It uses quantitative data collected through a questionnaire and qualitative data gathered from design studios' observations during the academic year for architecture design studio sessions. The aim of such data is to monitor the effectiveness of blended learning during design studios and to recognize the different challenges and benefits from the point of view of both students and tutors.

The study sample is mainly selected from architecture students of the 7<sup>th</sup> and 8<sup>th</sup> semesters in addition to some of the faculty members at DU who used blended learning during the pandemic in their architecture design studio courses. The sample includes approximately 60-88 students and 25-35 faculty to provide a balanced view of both experience and practice.

The research limitations are mainly related to the study at Delta University for Science and Technology where the results refer to the steps taken through the pandemic. Nonetheless, the framework produced could be generalized to other architecture programs.

## 3. Architecture design studios (face-to-face)

Studio-based learning in architectural engineering colleges introduces the students to an environment where they can innovate and develop productive ideas through meeting different peers from different backgrounds and cultures. It enhances and enriches the designing process, starting with the initial idea through design decisions and finally to a new project (Little, P. and Cardenas, M. (2001). Self-awareness and confidence are two qualities that architecture students cultivate to produce architects who can meet the needs of society. Architecture students' design studios are based on some aims and objectives introduced independently through the program of each faculty. All of these programs take up the same design process that indicates stages beginning with brainstorming, research, and idea development to reach the final product with an appropriate scale and well-defined aesthetic criteria (Gilbert Herbert, 1966). In this respect, architectural education studios fulfil three specific duties; teaching and practicing some skills such as drawing and performance, teaching the language of the panel and the ability to express, and teaching architectural thinking to solve problems (Saghafi, M.R., Mozaffar, F., Moosavi, S., & Fathi, N. (2015). Table 1 offers an overview of the steps needed to design a development plan as follows:

Table 1: The six steps of the design development plan

Criteria	Definition	source
1-Studio Environment - Physical Space - Resources	The studio offered by the institute is designed as a workspace where students can work either in private or in a team. Additionally, the open layout of the studio offers a collaborative and interactive area with access to computers, the internet, libraries, and model-making workshops that facilitate the hands-on nature of studio work.	Hettithanthri, Upeksha & Hansen, Preben & Munasinghe, Harsha. (2022).
2- Project briefing - Introduction - Research & analysis	The instructor presents the project in a brief outline to ease the process of research. It includes design challenges, objectives, constraints, and requirements. Then, the student goes for the initial research to answer most of the given design questions.	Hettithanthri, Upeksha & Hansen, Preben & Munasinghe, Harsha. (2022). (Park, Sohyun. (2020)
3- Concept development - Idea generation	It includes the brainstorming phases, developing initial design concepts through sketches, diagrams, and study models, and refining the concept in its early stage, and that phase encourages creativity and exploration.	Hettithanthri, Upeksha, et al.(2022). (Park, Sohyun. (2020).
4- Design development. - Detailed Design - Technical Integration	In this stage, the student moves from the conceptual stage to a detailed design proposal, producing more detailed drawings and prototypes, and gradually integrating the technical aspects such as materials, environmental sustainability, and structural system.	Hettithanthri, Upeksha & Hansen, Preben & Munasinghe, Harsha. (2022). (Park, Sohyun, (2020).
5- Critiques and Reviews - staff comments - group discussion	Students exchange their knowledge through public discussions during prefinal presentations. Additionally, staff members offer one-to-one discussion feedback and guidance to help students overcome specific design challenges.	Hettithanthri, Upeksha & Hansen, Preben & Munasinghe, Harsha. (2022). (Park, Sohyun, (2020).

6- Final Presentation - Jury Review	The final electronic or freehand presentation material collected throughout the design class and after refinement and correction includes final drawings, renderings, models, and a cohesive narrative outlining the design process and solutions.	Hettithanthri, Upeksha & Hansen, Preben & Munasinghe, Harsha. (2022). (Park, Sohyun. (2020).
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Face-to-face design studios are considered a difficult, engaging, and interactive process that involves the practical participation of the students during the design studio. Students develop both technical and creative problem-solving abilities via hands-on work, regular feedback, and collaborative learning, which prepares them for the complexities of professional architectural practice (Adiloglu, F, 2011).

Chicago Architecture Center (CAC) defines six steps of the architecture design process (Figure 2): defining the problem, collecting information, brainstorming and analyzing ideas, developing solutions, gathering feedback, and improving (Center (CAC), 2019).

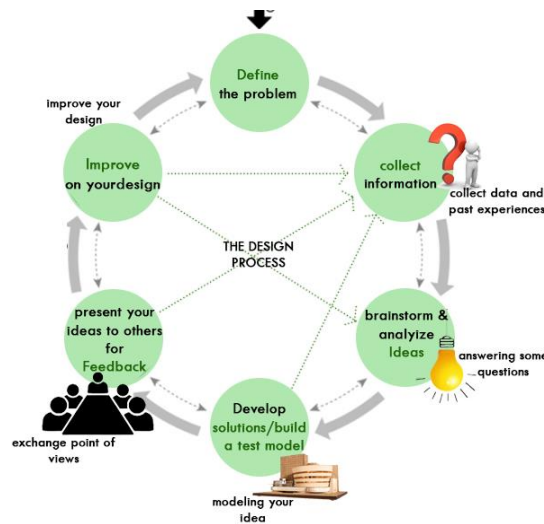


Figure 1: The 6 steps of the design process according to the Chicago Architecture Center  
 (Source: <https://discoverdesign.org/handbook>, adapted by the researcher)

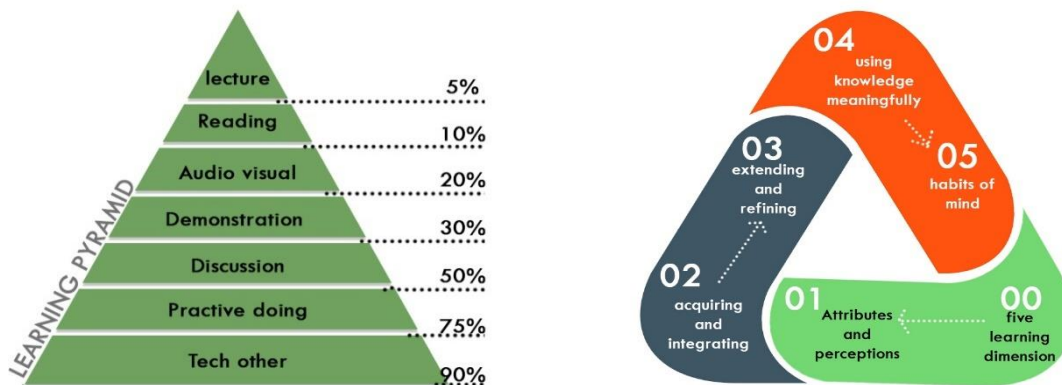


Figure 2: The theoretical basis of the assessment framework (a) Five learning dimensions; (b) Learning pyramid (Liu, 2021)

The learning pyramid shown in Figure (2) demonstrates the effectiveness of different teaching methods that require students to participate actively in the learning process. It is divided into two groups: passive learning (the first four layers) and active learning (the last three layers) (Tabrizi, Sirous & Rideout, Glenn. (2017). Bloom's classification (Table 2) depicts the level of quality that is achieved in the different stages in the architectural design studio (Tayfun Yildirim, Arzu Ozen Yavuz, Nazan Kirci, 2012). Moreover, Figure (3) links the learning pyramid to the architectural design process through Bloom's classification.

Table 2: Bloom Taxonomy in Architecture Design Studio (Source: Nik Ibrahim, Nik Lukman & Utaberta, Nangkula. 2012)

Bloom Taxonomy in Architecture Design Studio	Categories	Explanation	Learning in design studio
	Knowledge	Knowing the information taught	Knowing the design requirements
	Comprehension	Showing understanding of the material interpreting restricting knowledge.	Understanding the objectives of the design requirement
	Application	Using the information to solve problem	Using the information to execute design or to solve the design problem
	Analysis	Critical thinking cause and motives; making function based on facts; making a hypnosis	Critical thinking: identifying /analysis the effectiveness of design components; making design decision based on facts.
	Synthesis	Original thoughts: original proposal	Proposing new and original design solutions without borrowing literally from precedents.
	Evaluating	Evaluating merit of the idea, benchmarking formulating conclusions	Evaluating the merit of the proposed design solution (e.g., the effectiveness of space configurations...etc.)

#### 4. Flexibility and adaptability of architectural design studios

Multiple discussions have emerged on the challenges of architectural education after the last crises including pandemics and other unstable conditions (Mohamed Mahmoud Saleh, Morad Abdelkader, Samir Sadek Hosny, 2023). One of the challenges is the role of teachers and institutions to provide flexibility to adapt the blended learning idea as part of the structure of the architectural education curricula. Moreover, another challenge is the emergence of information and communication technology (ICT) and the necessity of integrating it into architectural education. This helps to provide a variety of knowledge to the learning process. Technology is widely used in the field of architecture and is used in all design and manufacturing processes. Therefore, digital computer technology has a great impact on architectural education as it is used to create fundamentally new educational experiences and programs. In response to the post-pandemic period, a reconsideration of architectural education using default settings is adopted. The use of information and communication technology in architectural education offers new teaching practices in architectural design studios and improves student performance.

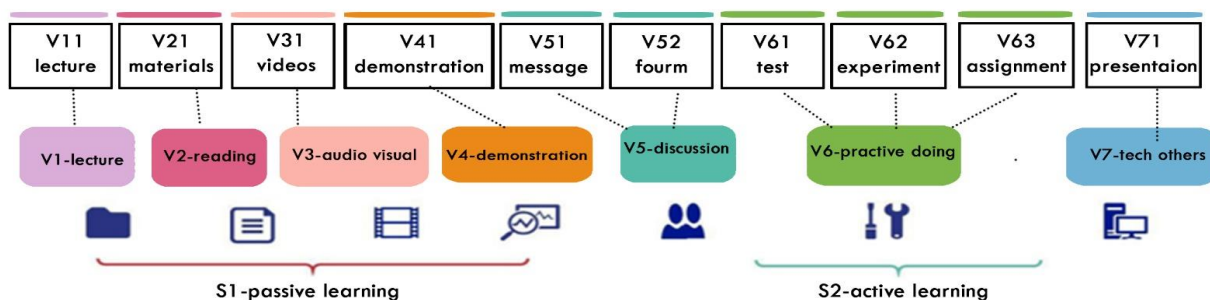


Figure 3: Linking the learning pyramid to the architectural design process via Bloom's classification (Liu, 2021)

Table 3: A comparison between face-to-face and virtual design studio application

	Face-to-face Architectural Education	Online learning	Source
Techniques	<ul style="list-style-type: none"> <li>- <b>Working with their own hands:</b> Essential to architecture education, allowing students to work on tangible models, drawings, and collaborative projects and ensure that the student fully understands the application of the design project.</li> <li>- <b>Self and group criticism:</b> conscious comments from instructors and peers during design critiques and juries.</li> <li>- <b>Workshops and laboratories:</b> provide access to specialist equipment and resources for model-making, manufacturing, and other hands-on activities.</li> </ul>	<ul style="list-style-type: none"> <li>- <b>Digital Design Tools:</b> Design assignments mostly is carried out using CAD software, BIM tools, and virtual modeling platforms to ease the process of handling and sending.</li> <li>- <b>Self and group criticism:</b> Virtual studio sessions, presentations, and critiques may be conducted online using systems such as Zoom, Miro, and advanced tools to help the process.</li> <li>- <b>Interactive Tutorials and Simulations:</b> Use video lessons, virtual reality, and augmented reality to create interactive learning experiences and virtual walkthroughs.</li> </ul>	Mebert, L., Barnes, R., Dalley, J., Gawarecki, L., Ghazi-Nezami, F., Shafer, G., ... Yezbick, E. (2020). Salama, Ashraf & Crosbie, Michael. (2020).

<b>Methods</b>	<ul style="list-style-type: none"> <li>- <b>Lecture-Based Learning:</b> Traditional classroom lectures covering architectural theory and history.</li> <li>- <b>Studio Culture:</b> a collaborative learning setting in which students work alongside one another, encouraging peer learning and mentoring.</li> <li>- <b>Field outings and site visits:</b> Visits to architectural sites and projects for experiential learning.</li> </ul>	<ul style="list-style-type: none"> <li>- <b>Recorded and artificial connection:</b> Pre-recorded lectures and materials are available at any time, enabling self-paced learning.</li> <li>- <b>Synchronic Sessions:</b> Participate in live online classes and discussions with professors and peers in real-time.</li> <li>- <b>Digital Collaboration Tools:</b> Use systems such as Google Drive, Slack, and Trello for collaborative work and communication.</li> </ul>	<p>Le, Kien. 2022.</p> <p>Mebert, L., Barnes, R., Dalley, J., Gawarecki, L., Ghazi-Nezami, F., Shafer, G., ... Yezbick, E. (2020). Salama, Ashraf &amp; Crosbie, Michael. (2020)..</p>
<b>Time-consuming</b>	<ul style="list-style-type: none"> <li>- <b>Lecture in Campus Time:</b> The time spent getting to and from campus and between classes.</li> <li>- <b>Classes timetable:</b> Classes and studio sessions follow a set timetable, which may affect flexibility.</li> <li>- <b>Extended Studio Hours:</b> Working long hours in the studio, especially around project deadlines, can be helpful for students who need extra care to ensure a better understanding of the information.</li> </ul>	<ul style="list-style-type: none"> <li>- <b>Flexibility:</b> Reduced traveling time and more flexible scheduling help students to better manage their time.</li> <li>- <b>Time Management:</b> Self-discipline and time management skills are required to keep up with asynchronous content and deadlines.</li> <li>- <b>Potential for Increased Efficiency:</b> Streamlined procedures and digital technologies can speed up some operations, such as exchanging digital models and getting feedback.</li> </ul>	<p>Le, Kien. 2022.</p> <p>Mebert, L., Barnes, R., Dalley, J., Gawarecki, L., Ghazi-Nezami, F., Shafer, G., ... Yezbick, E. (2020). Salama, Ashraf &amp; Crosbie, Michael. (2020)..</p>

Developing teaching methods in architectural design studios to adapt the new online method helps to reformulate the way architects learn by integrating face-to-face learning with online learning. This, in turn, helps to modernize the concept of design studio and transform it into new participatory learning by integrating technical methods and applying digital tools to carry out the process of blended learning (Ashraf M. Soliman, 2017). Thus, a common ground space for education is created so that students and teachers can work and communicate with everyone regardless of their place and time ( Masdéu, Marta & Fuses, Josep. (2017)

The combination of traditional methods and digital technologies enables the students to acquire new professional skills and master digital technologies to manage the dissemination of architectural knowledge, improve their ability to learn, and enhance the acquisition of educational experiences by encouraging them to develop new interests and relationships outside the studio and the academic environment. The use of information and communication technology provides tools and scenarios that are distinguished, mobile, and connected to the network (Masdéu, Marta & Fuses, Josep. (2017).

**5. Design studio in architecture design courses (a monitored class)**

Courses in design are compared to other architecture courses which carry the highest average number of contact hours per week. Other subjects such as Construction Technology, Architectural History and Theory, Environmental Physics, Design Communication, and others have to support design studio learning each semester. In general, design studios continuously provide students with the knowledge and expertise necessary in order to fulfill the aims and objectives of the course specification introduced through the architecture program offered by each educational system (yıldırım, Selda. (2012).

Architectural design education aims at improving creativity and differs from other educational systems. It is based on providing an environment in which information is transferred directly from the teacher to the student and new solutions are found. The main feature of an architectural design studio is the interaction between students and teachers (yıldırım, Selda. (2012). Developing the students' imagination in design and allowing them to innovate and conduct architectural design that has a smooth dialogue and balance between function and aesthetic thinking is the desired product for the interaction in the design studio. Design Studios teaches architectural students how to work in both intuitive and practical situations. Students in design studios use a variety of communication strategies and approaches to exhibit their architectural ideas and creativity, including drawings, physical models (Figure 4), computer models, photography, video clips, and more.

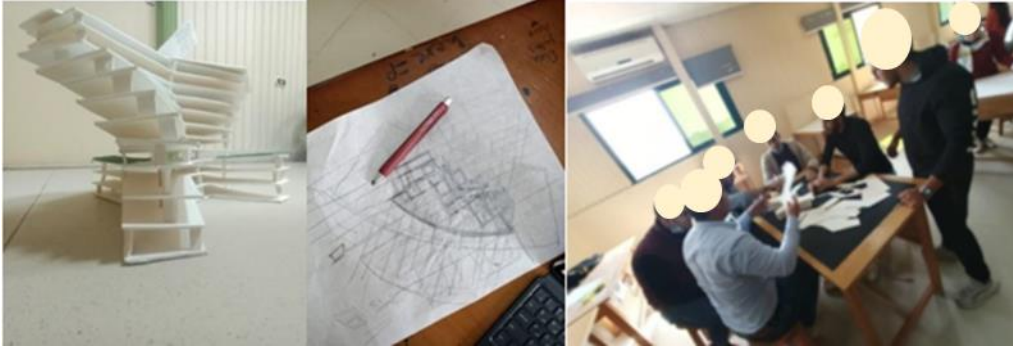


Figure 4: Part of the interactive teamwork inside the design studio for a residential house (Source: architecture class 2020/2021)

The targeted university's architecture curriculum contains a core section for architectural design courses represented by six core modules in a row. The modules are designed to prepare the student with the needed principles, practical application, and theoretical knowledge required to move on with the design process's courses aimed to enhance creativity, and critical thinking, and consider the inference of the environmental discipline. The first modules introduce students to the basic principles of architectural design, spatial organization, and visual communication and range from small residential units to designing units in clusters. The second module introduces the design of public and civic buildings, with an emphasis on creating spaces that enhance community well-being. The third module mainly investigates the environmental and sustainable design concepts in bigger and more complicated public buildings. The fifth module introduces the complexity of building projects, like high-rise buildings and mixed-use buildings. The last module mainly works on the design and planning scale concerning professional architecture practice, where the student should respect project management, culture, and client relations and needs.

The targeted design modules were the fifth and sixth modules, where students were orientated toward a mixed-use building and a culture center in the context of the new Mansoura city.

Contact hours of design studios usually range from four to six hours per week. A design studio consists of at least 6 contact hours per week; one hour for theoretical data illustration and lectures, and the remaining five hours for discussion and assessment of the students' work. It is mainly dedicated to improving the design ideas of the students, especially for those who have design problems or are delayed in their ideas for the project (Hettithanthri, Upeksha & Hansen, Preben & Munasinghe, Harsha. (2022).

At Delta University for Science and Technology, Egypt, many design courses usually follow the basic design stages and project development stated in the course specification, starting with the research and problem finding, discussing research outcomes, extracting design decisions from the previous studies, and research as a first step. The second step, which takes a longer time, is to develop the design decisions made to meet the complexity of functions in any proposed project (Center (CAC), 2019). The third step is to extract the 3D dimensions of the project to be closely examined and ensure that they meet the function and needs of the building to be designed.

Furthermore, for the architectural department at Delta University for Science and Technology, virtual studios face some obstacles within the three phases. This encourages the course coordinators to overcome the problem of interaction by making many assignments and increasing the hours of virtual contact with the students by way of dividing them equally among the three phases with each coordinator. Further effort is exerted to update the tools of the coordinators to narrow the gap between old computers and laptops with no actual interaction and the more advanced and high-tech tools for better and faster interaction.

### 5.1 Managing Blended Architectural Studios

Many architecture academic professors believe that architecture design studios cannot be activated online via virtual studios as they should be interactive and fruitful (Ceylan, Salih & Sahin, Pınar & Seçmen, Serengül & Somer, Melek & Süher, Kemal. (2020). While trying to boost creativity through online meetings and assignments, blended architecture studios proved to be possible. However, much effort is required to complete the process. The following plan (Figure 5) is extracted as new practices that use information and communication technology are developed. The architecture department is used as a case study to enhance and develop the idea of blended learning.

It helps and boosts the educational system, especially those courses that need direct interaction, such as architectural design, building construction, and execution drawing courses. It depicts the following steps:

- First, all the academic lectures and educational material should be uploaded weekly for the students with the required assignments attached and explain how to handle the feedback through the DULMS platform.
- Second, schedule a Zoom meeting for students to discuss their work in teams or individually after dividing them into groups by the staff members.
- Third, give a graded weekly assignment on a due date similar to the ones they used to have during the actual meeting in the architectural studio.
- Fourth, after they can access the assignment, students can download the assignment and start working on it either manually or freehand, especially at the early stages of the design studio, and then upload their work online on the link of the assignment.
- Fifth, the academic staff starts to download the assignments of the students individually and review them with both manual and written feedback for students (Table 4). Extra time could be given to students who need help to boost their work. Throughout the whole process, DULMS, which acts as the web portal, is the main communication tool in the design studio.

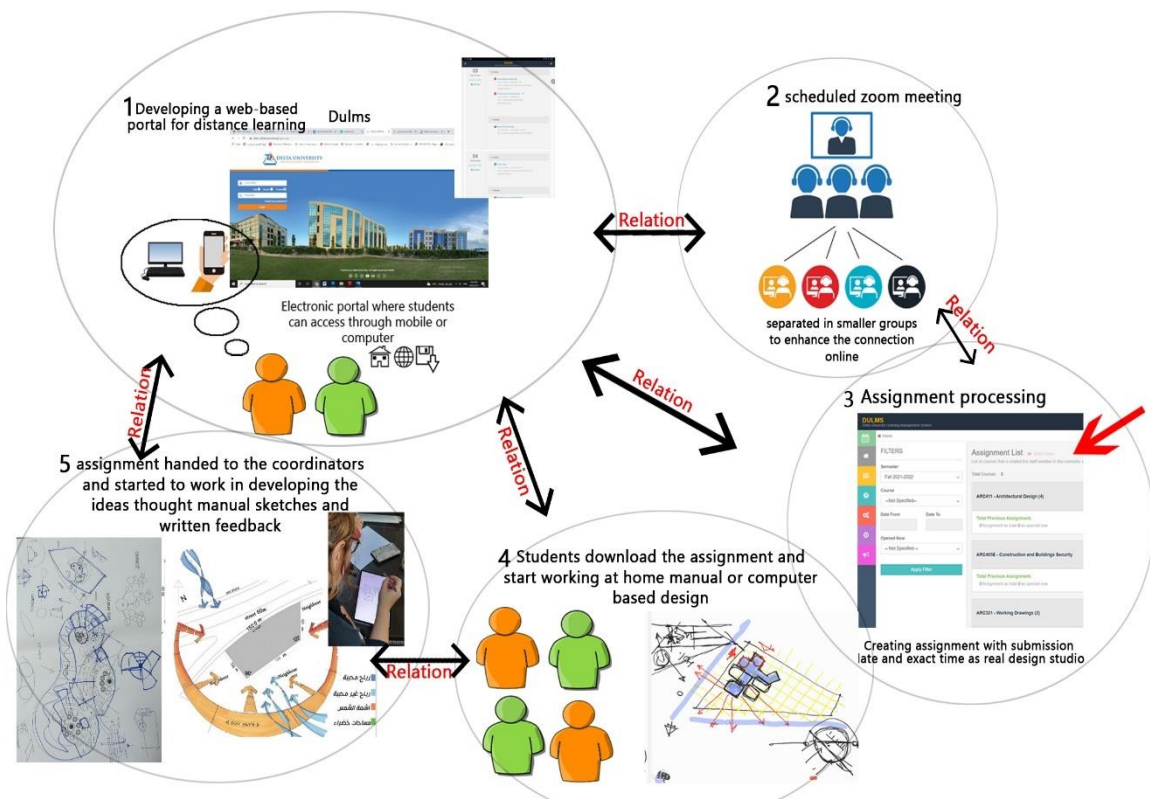


Figure (5) The plan developed by the department to engage face-to-face and online learning altogether (Source: The author)

Design studios are mostly known for adapting the idea of a final jury to help all students get comments from their peers and tutors to improve and enhance the design idea of the whole project, which is disabled by moving to online learning and virtual design juries (Salem, W. (2016). The architecture department introduced the smart projector with an interactive face, which helped the tutors get more information and interactions with their students through virtual meetings and virtual juries.

Table 4. The virtual design studios -Fifth Phase- Download the assignment -Editing- Private comments (Source: The researchers)

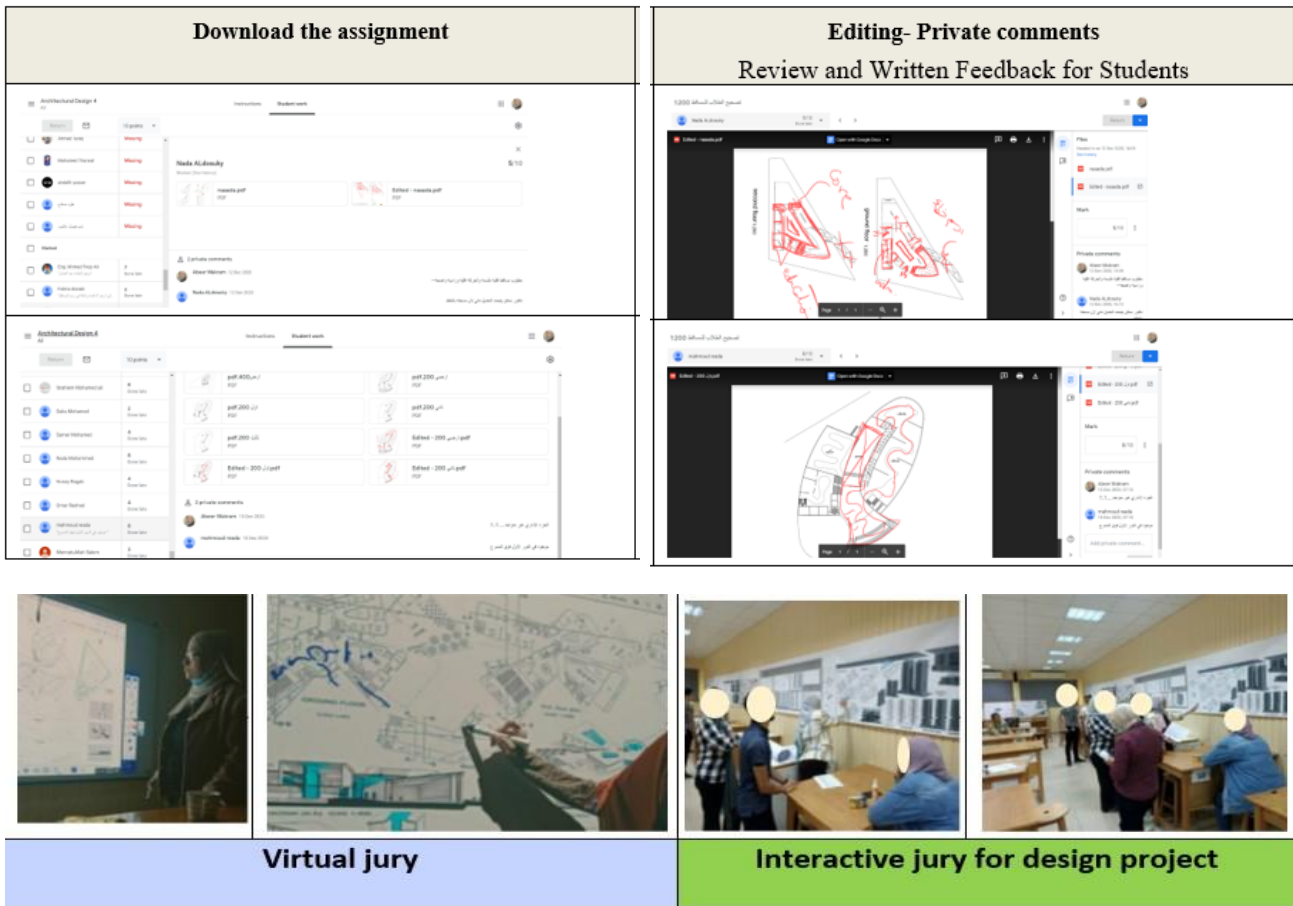


Figure 6: The difference between virtual and face-to-face jury (Source: The author)

## 5.2 Design studios results and participation

### • Survey on students’ perception of blended learning design studios

After the challenging conditions posed by the pandemic experienced in the past few years, online learning was brought to the surface. Educators and students face the challenge of adapting to the online learning technique to complete the academic semester effectively (Gritsova, O.A., & Tissen, E.V. (2021).

Students have to face many challenges, especially in handling their work online through DULMS. In addition to upgrading computers and laptops to cope with the digital system software AutoCAD or 3D MAX, students face other challenges such as poor connection, printers, drawing papers and study model materials, and many other obstacles while receiving and sending their assignments.

Therefore, an investigating and monitoring survey is conducted after the end of the online design courses to evaluate the real impression of online learning, stand on the problems that the students face, and overcome future problems while enhancing the system of learning.

The survey is mainly conducted on architectural design students with varied levels of GPA to examine their opinions and experience of online learning for design studios throughout the term. It includes the second-, third-, and fourth-year students of architectural design studios. Moreover, the survey is designed on the Google Forms platform as a free online survey tool.

The survey mainly consists of thirty-three questions attached to an introduction about the students' GPA, level, age group, and the current design studio they enrolled in. It is made up of two essay questions and thirty MCQ questions. Most of the questions are designed to measure the satisfaction of the student while using the online portal; how they

manage to submit their digital work online and how they evaluate all aspects of the design process. An additional question is added to get the students' feedback on how to improve online architectural studios.

The survey received 88 responses, 31 female and 57 male, with a GPA ranging from 1.5 to 3.7. It targeted mostly students from levels 3 and 4 who are enrolled in architectural design 4 and 5.

• **Results of the survey (students)**

According to the survey, 52.6% of the students believe that technology has aided the online learning process, while 26.3% have a contrary viewpoint. In addition, 63% think that it is easy to deal with the online DULMS portal of the college while 36.8% think it was not that easy. Where assignments are uploaded by staff members, 39.5% of the students find it easy to understand while 13.2% find it difficult and require more illustration (table 4).

As concerning the direct contact between the student and his/her staff member, which is a key component of architectural design studios, 44.7% of the students agree that they could communicate and make discussions directly through Zoom and other online meetings, while 23.7% disagree that they could contact their staff members as freely as direct contact in design studios. Most of the students with a percentage greater than 63.2% attend the online lectures on time, while the rest prefer recorded lectures, which allows them to concentrate more while studying (Table 4). Most of the students, 63.2%, did not find any problem dealing with the university portal whereas 36.8% found it useless. In addition, 44.7% of the students find that, in distance learning, dealing with teamwork during studio is an easy task whereas 42.1% think differently. In short, the students rated the whole online experience by an average of 7 out of 10 (Table 5).

Table 5: The student’s questioner results about the direct contact between them and using technology

Questions	Agree	Strongly agree	disagree	Strongly disagree	Null
In case of pandemic, I do recommend the distance learning as interactive system for design studio	39.5%	28.9%	13.2%	13.2%	5.3%
The way the staff handle the design studio was effective and easy when distance learning than the design studio	39.5%	2.6%	23.7%	26.7%	7.9%
The distance learning succeeded to add to my experience some new opportunities	52.6%	13.2%	26.3%	5.30%	2.6%
It was easy for me to get my studio notes from my staff while distance learning	31.6%	5.3%	34.2%	23.7%	5.3%
It was easy for me to reach my staff member while distance learning	44.7%	13.2%	23.7%	15.8%	2.6%
I was attending all my online design studio sessions that belong to the design course	63.2%	13.2%	7.9%	7.9%	7.9%
The university portal for distance learning where effective and reachable	44.7%	18.4%	23.7%	7.9%	5.3%
The distance learning where an easy task for staff to communicate with students during the term	31.6%	15.8%	21.1%	15.8%	15.8%

The results of the previously mentioned survey are assessed independently according to the sequence of the questions and with respect to the student’s opinion throughout the whole process. All are linked and related to the student level inside the real and the virtual studio.

The results and answers mainly show that students at the lower level are very excited about continuing the rest of the architectural design studios online using technological means (laptops, projectors, presentations, etc.)

Table 6: The student’s questioner results about the direct contact between them and the staff members

Questions	Yes	no	Don't know							
It was easy to deal with the university portal (Dulms)	63.2%	36.8%	0.0%							
Dealing with a team work was much easier than the ordinary design studio	44.7%	42.1%	13.2%							
Questions	Excellent	Very good	Good	fair	null					
What is your opinion about the assignment introduced with Dulms	18.4%	28.9%	23.7%	26.3%	2.6%					
From 1 to 10 evaluate your experience of distance learning										
Grade	1	2	3	4	5	6	7	8	9	10
Number of students	3 students	1 student	2 students	1 student	5 students	4 students	7 students	5 students	4 students	6 students

• Faculty and Department Questionnaire Results

Another questionnaire is conducted to examine the perspectives of the academic staff regarding the experience of blended learning and its outcomes, particularly on design studios and practical courses. It aims to provide a comprehensive picture and to better serve the community and the department. The findings are used to assess online and distance learning in the department and faculty services unit and identify the areas of improvement.

The questionnaire is available in an online form to facilitate the transfer of data. It consists of 17 questions involving the academic experience of the staff during the period of the COVID-19 pandemic.

The survey collected 32 responses, 72.2% from assistant professors, 18.2% from associate professors, and 9.1% from associate professors. 72.7% are female and 27.3% are male academic staff members. 36.4% of the courses studied during COVID-19 are graduation courses and design (4) (third level), compared to 18.2% for design (3) (second level) and design (1) and 9.1% (level 1).

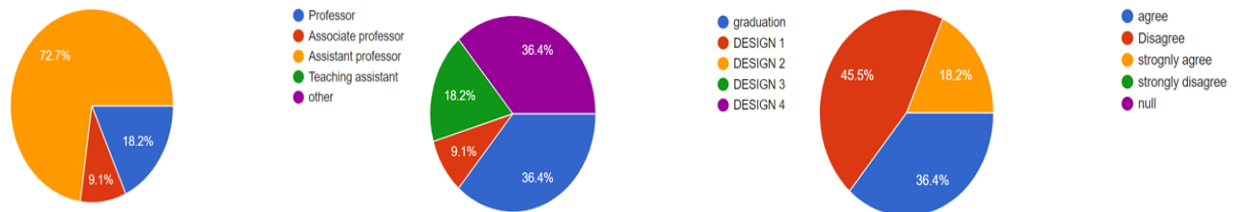


Figure 7: Part of the academic staff questionnaire results

Most of the respondents (Figure 7) have taught design several times before. A percentage of 90.9% and 9.1% of the academic staff members have no experience in design studios before that year.

By asking about the ability of distance learning to "help students at different levels," most of the answers are negative, with a percent of 45.5 to 36.4 positive answers. Additionally, 18.2% strongly agree that it can help the students and give good results in design studios. Finally, 54.6% agree that distance learning can help students in different learning aspects whereas 45.5% disagree.

One of the most common problems introduced by the questionnaire is that most of the time it is difficult to connect online. Most of the academic staff members stated that the number of students in online classes is way less than in the real design studio. Moreover, it is stated that the most important tool in distance learning is smart boards and the high technology applied to computers inside the campus, followed by the importance of a high-speed internet connection accompanied by professional teaching staff.

Most of the academic staff members agree that the online content for the course is available and clear to be evaluated using DULMS or any other virtual meeting class with a percentage of 63.6 to 27.3. Additionally, the process of online evaluation is clearer and easier. Furthermore, they stated that the online design studio takes much more time than the real design studio as they have to work with each student individually.

Most of the recommendations stated by the academic staff members do not support full-time distance learning and encourage the process of blending both online and face-to-face studios. Some important notes are mentioned as follows:

- Design courses should be developed to cope with the online interactive studio timetables for both students and teachers and to be more flexible to adapt to the e-learning timing studios as it takes more time to aid in the process.
- Students should enroll in basic computer skills programs.
- Blended learning makes education more accessible.
- Distance learning is not an efficient learning method.
- It is preferable to communicate with students face-to-face throughout the process where tools to assist students in learning could be much better.
- Online learning is great for helping students who would not otherwise have access to university courses.

## **6. Results**

The whole experience of transforming online architecture design studios into virtual studios is an evolution in the educational systems. Dealing with the pandemic or other crises that involve blended learning through this development presents real opportunities and challenges. The study indicates that most students are connected to the use of online technological tools and are open to the experiment as they are accustomed to interacting with social media platforms and online meetings on both the social and educational levels. They view the studio as a platform that they can handle more effectively. Additionally, most of the recommendations stated by the academic staff members do not support full-time distance learning and encourage the process of blending both online and face-to-face studios.

The research contributes to developing a framework (Figure 8) that links the architectural design process and the learning pyramid through two groups: passive learning and active learning. It demonstrates the effectiveness of different teaching methods that require students to actively participate in the learning process through Bloom's taxonomy in the architectural design studio, which takes into account the level of quality achieved at different stages.

Based on the previous results, the research introduces a framework that enhances flexible blended learning in architecture studios as follows (Figure 8).

The integration of face-to-face design studios and remote learning contributes to the creation of a more flexible, inclusive, and successful learning environment for architectural design students. It makes architectural education more accessible to a broader spectrum of students, such as part-time students, international students, and those with physical disabilities. Students can better organize their time by reviewing previously recorded lectures or feedback sessions. In addition, technology can be optimized by combining manual and digital processes, both of which are crucial in modern architectural education.

On the one hand, combining association and teamwork gives the students an opportunity to be more prepared for the globalized nature of the architectural profession, which frequently demands distant interaction with overseas teams. Besides, the feedback mechanism is improved to provide the students with a range of feedback techniques and quick replies to respond to the comments of their touters online. On the other hand, blended learning helps to maintain sustainability within the learning environment allowing a reduction of the physical resources.

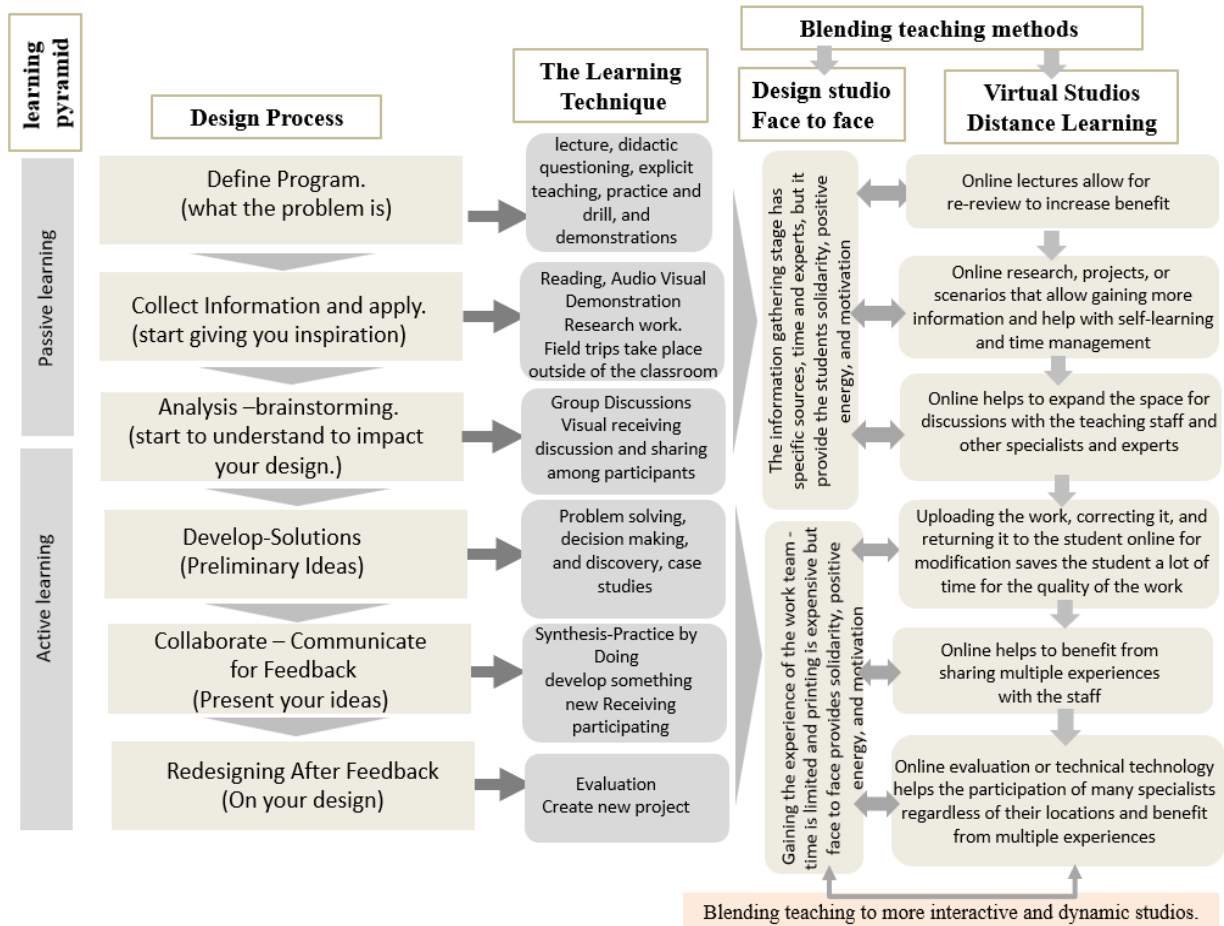


Figure 8: Framework that enhances the flexible blended learning in architecture studios as follows offered by the researchers

## 7. Conclusion

By combining face-to-face design studios with distant learning via visual technologies, architectural education becomes more adaptable, accessible, and in line with the current practice. Students benefit from in-person engagement and hands-on learning while simultaneously gaining important digital skills and cooperating in a globalized setting. This hybrid method improves learning results and flexibility in professional architecture situations.

The study concluded that the characteristics and nature of the design studio should govern the entire process of architectural design courses. Furthermore, this process should be integrated and equipped with online and virtual studios that are in line with the digital age to promote more blended learning and provide more flexible teaching methods for students in the architectural design studio. This integration facilitates the continuity of education in times of isolation and disasters and promotes self-learning and time management. Additionally, it simplifies the process of evaluation and criticism of student projects at some stages of the design process which has a significant impact on developing the future path of architectural education toward more interactive and dynamic architectural design studios.

The research contributes to developing a framework (Figure 9) that promotes blended learning for the architectural design process to provide more flexible teaching methods for students in the architectural design studio. It combines the traditional studio that provides a stimulating work environment, achieves solidarity, and gives positive energy to students with the virtual studio that promotes self-learning, brainstorming, and skills. This can be achieved through meetings with diverse practices of specialists, professionals, and faculty members to enhance their experiences and educational capabilities. Thus, it helps students to be more creative and productive. In addition, it saves students time and costs in the development, presentation, and evaluation stages, helps expand the design studio with digital technology, and creates a fun interactive learning environment through social, physical, and virtual environments. This study opens the way for many studies to enhance flexibility in teaching through architectural design studios. It

attempts to achieve several future goals that focus on mastering digital technologies to manage the dissemination of architectural knowledge and improve the quality of architectural design education.

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### Ethics approval

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### Conflict of interest

The authors declare that there is no competing interest.

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