Architecture students’ satisfaction with and perceptions of online design studios during COVID-19 lockdown: the case of Jordan universities

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Abstract

Purpose – The purpose of this study is to examine the attitudes of students in higher educational institutions in Jordan towards the use of online design studios during coronavirus disease 2019 (COVID-19) lockdown and discusses how their use could enhance the learning process.

Design/methodology/approach – 615 undergraduate students studying architecture in Jordanian universities were recruited to explore the factors that constituted and affected their perceptions of online design studios.

Findings – The findings of this study highlight that many of the participants felt uncertain about aspects of their online learning experience and wanted more guidance and support. Reasons of this disengagement include technical factors, such as poor network quality and lack of familiarity with the new applications. Students and tutors’ personal situations when working and studying from home are also relevant due to the tutors’ lack of expertise in online teaching, and the limitations of peer interaction. Together, these factors can make the experience of the online design studio more challenging.

Research limitations/implications – The sample was nationally representative of architecture students from various institutions. However, the study was limited to an exploration of students’ opinions, and it did not include the points of view of tutors and decision-makers.

Originality/value – This research was conceived during the period of the COVID-19 lockdown, whilst both tutors and students were experiencing dramatic changes in their modes of teaching and learning due to the sudden move from on-campus design studios to a virtual alternative, with only the bare minimum of resources and relevant experience. Learners’ perspectives can enhance understanding of online design studios to assess their quality and effectiveness.

Keywords Online learning, Design studios, COVID-19, Students’ satisfaction, Students’ experiences, Architecture

Paper type Research paper

Introduction

Over the last decade, there have been moves towards virtual teaching of design courses. In their introduction to Design Studio Pedagogy: Horizons for The Future, Salama and Wilkinson (2017) argue that online design studios will not replace the traditional studio in the future. This question of the adoption and adaptation of the online design studio as a replacement of the traditional form has been investigated by various researchers and educators. Silva and Lima (2008) compare the challenges and strategies of online teaching and traditional architectural education. They suggest that face-to-face activities, such as peer-learning, are essential for the teaching and learning of design, and a full online mode...
simply could not be successful. As such, Saghafi et al. (2012) suggest a new and blended design studio that combines the traditional physical studio with a virtual model.

However, due to the threat of coronavirus disease 2019 (COVID-19), the architecture institutions in Jordan – as in many other countries – have opted to cancel all face-to-face teaching and offer solely online teaching. Due to the lockdown policies, educators and students have experienced dramatic changes in their modes of teaching and learning, moving from traditional teaching in design studios on campus to virtual courses, with only the bare minimum of resources and experience. Most – if not all – educators are dealing with new applications that were introduced to them and their students only days before the start of online teaching. Educators and students had different levels of digital fluency and have never before engaged with this type of teaching and learning experience.

Students’ experiences of online learning in architecture (and other subjects) can be influenced by numerous factors, which have been explored in several studies. Table 1 summarizes the factors influencing students’ satisfaction in the online environment, citing three central issues: the tutor, the technology and interactivity. Several other elements also affect the online learning experiences. These elements include administrative issues, social interaction, academic and technical skills, motivation, time, limited access to resources and technical difficulties. Other factors identified as barriers include unfamiliar roles and responsibilities, delays in feedback from tutors, limited technical assistance, high degrees of technology dependence, and low student performance and satisfaction.

While there is a considerable quantity of literature on the online learning environment, in all such studies, the online courses were assumed to be well-planned, with educators having prepared their courses in advance of joining the online platform; thus, their contexts are very different to the rapid, ad hoc redevelopment of the teaching model that we have seen during

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<td>One-to-one dialogue, collaborative context and process-focus evaluation</td>
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Table 1. Literature considering the factors affecting students’ experience in online learning
COVID-19. Therefore, there is a need to examine the quality of this online learning and to explore the associated challenges and opportunities.

Active learning in the design studio
Learning as interactive process is an important issue in architectural design education (Maghool et al., 2018). The design studio, which is at the core of architectural education, is taught through a project-based studio approach in which students are engaged socially and intellectually in different sets of activities, such as model-making and drawing, while shifting between analytic, synthetic and evaluative models of thinking (Dutton, 1987). Therefore, the unique nature of the “learning by doing” approach that we adopt in design education is a vital issue that must be taken into consideration when investigating this emergency model of online learning.

The design studio environment is different to that of the traditional classroom – from pedagogical, sociological, ideological and epistemological points of view (Sagun et al., 2001). The design studio is greatly distinguished from other learning environments by the use of peer learning, one-to-one interaction with tutors, frequency of tutorials and feedback, and field trips and site visits. The design studio is both a learning environment and a complex social setting in which students are encouraged to work together with their peers even outside of the designated course hours, without the presence of their tutors (Lueth, 2008).

However, since the design studio became virtual, students have remained in contact with their design tutors via various applications during the designated time only, discussing their work individually or as a group. The regular reviews in which students pin their work to the studio walls and engage in discussion with their tutors and perhaps other reviewers in front of their peers were replaced by virtual rooms, where each student displays and discusses their own work with their tutor and one or two reviewers, potentially without the presence of the other students. Moreover, as model-making is an essential part of the design process, students usually spend a large proportion of their time in the studios and workshops, working on their models. Due to the lockdown, students have been left without resources such as workshops, tables, and even the cardboard and other materials to build their models.

Methodology
As noted in the introduction, this study explores the drivers of students’ perceptions of the quality of their online design courses. It was decided that quantitative measures would usefully supplement and extend this aim, as we were interested in what we could learn from our current students about learning and teaching practices, in terms of both learning quality and the possibility of adopting virtual learning environments for future design courses.

Consequently, rather than collecting data on just the current experience (including workload and time spent weekly on online learning), we wanted to gather deeper insights into the aspects of online learning that architecture students valued most highly, identifying why they valued these aspects, what they found challenging about them, and why. Greater understanding of students’ attitudes will allow us to determine and evaluate the strengths and weaknesses of this experience, providing the basis for development of future online teaching practice.

Study instrument
A questionnaire was created based on an analysis of the literature on online learning, including studies of the challenges of and barriers to online teaching in different programmes. Once the appropriate elements were identified, we focused on issues that directly impact teaching in the online design studio environment.

A preliminary set of 43 statements were derived from the literature and grouped into four dimensions: (1) learning engagement, (2) learning autonomy, (3) learning quality and
(4) learning behaviour. Students’ satisfaction was measured using 5-point Likert scale questions, with answers ranging from “strongly disagree” to “strongly agree”. A reflection section was added at the end of the survey to gather insights from students themselves into their learning experiences.

The first version of the survey was shared and discussed with a number of architectural educators currently teaching online design courses in universities in Jordan. They suggested some modifications, which were implemented, and also helped to determine whether the items were sufficiently clear and concise. Two questions were slightly modified before the questionnaire was made available online. All data were collected anonymously, and the responses contained no potentially identifying information. In addition, all participants were informed about the purpose of the study, the expectations for their involvement, the amount of time participation was expected to take, and the right of all participants not to answer any particular question and to withdraw from the study at any time. The final structure of the questionnaire is illustrated in Figure 1.

**Sampling and participants**

Architecture students from 15 universities in Jordan who took online design studios during the lockdown (March–June 2020) were invited to complete the online questionnaire. Of the 615 students who did so, 64.7% were attending public universities and 35.3% private institutions. The sample included 432 female students and 185 male; this imbalanced male, as female ratio is a characteristic of architecture schools in Jordan. All students provided information about their year of study, indicating that 113 were in their first year, 135 in their second year, 125 in their third year, 143 in their fourth and 99 in their fifth. The students were classified accordingly into four stages: foundation and beginner stage (including year 1 and year 2 students), intermediate stage (year 3), senior stage (year 4) and graduate project stage (year 5).

**Data analysis**

Students were invited to rate the statements in the questionnaire, using a 5-point Likert scale, from “strongly disagree” (1 point) to “strongly agree” (5 points). The higher the respondent’s score, the more positive their attitude towards online learning and the more positive their experience was deemed to be.

Descriptive statistics were produced using SPSS were utilized to measure students’ responses to the four dimensions: learning engagement, learning autonomy, learning quality and positive changes in learning behaviours (see: Figure 2). A correlation analysis was conducted to identify any relationship between the students’ satisfaction with the online studio and their level of study.

**Findings**

The data gleaned from this study indicate low levels of satisfaction with the online learning experience. Only 45.2% of the students described themselves as satisfied (a mean of 2.9). The mean scores for the four dimensions ranged from 2.7 to 3.5, with only 32.1% of the students indicating that they felt engaged during the semester. A similar number (36.7%) felt that they had developed autonomous learning skills, and only 34.4% were satisfied with the quality of learning they had received. However, a positive attitude towards learning behaviours was clearly evident in the students’ responses, with more than three-quarters of the participants (77.6%) indicating that they were using more online resources and relying on sustainable and reused materials for their design projects. The average values pertaining to the students’ views on the online design studio are presented in Table 2.
Similar responses were given to the open-ended questions. For example, one student responded as follows:

It’s one of the worst semesters ever as a design student . . . I do not feel motivated at all.

Another student expressed compared the online teaching in the design studio with the theoretical courses he was taking:
Online teaching is suitable for my other theoretical courses, but not the design studio.

**Learning engagement**

Students expressed the lowest satisfaction with learning engagement (32.1%), of the four dimensions. Learning engagement comprised four constructs: *ease of technology, tutor support, feedback,* and *peer learning and collaboration.* Tutor support ($M = 2.9, SD = 0.5$), feedback ($M = 2.4, SD = 0.2$) and ease of technology ($M = 3.3, SD = 0.6$) received the highest scores, while peer learning and collaboration ($M = 2.1, SD = 0.4$) earned the lowest score (see: Table 2).
Ease of technology

It is vital that the technology solutions deliver a learning environment for intelligent dynamic behaviour (Sawant et al., 2017). Technology is also considered a design tool that guides the creation, teaching and practice of design (Sleipness and George, 2017).

Zoom and Microsoft Teams were the most commonly used applications for online learning in Jordanian universities during COVID-19 (47% of architecture schools used Zoom and 38% used Microsoft Teams, whilst 15% used other applications, such as Skype and Google Hangout). The participants considered Zoom a user-friendly application, while Microsoft Teams was considered more secure.

As shown in Table 2, most of the students ($M = 3.3$) felt that ease of technology had been achieved in the online studio teaching. However, less than half (48.4%) of the students expressed positive attitudes in this dimension. Flexibility was the main positive indicator, reflecting the ability to run the application on a variety of devices (e.g. mobile devices, tablets, laptop and desktop computers), and there was 71.7% satisfaction in this dimension.

However, less than half (47.3%) of the students were satisfied with the application, and students in the foundation and beginning stages were particularly critical. This may be due to these students’ poor experiences of online learning applications and software in general. Participants mentioned that they need more user-friendly applications. In addition, more than 70% were struggling with poor Internet connectivity.

The following quotes highlight some of the students’ difficulties with managing the new applications:

We needed more time to learn how to use the new software and applications we had to use all of a sudden.

Tutor support

Tutor support is another key influence on students’ experiences during the learning process (Al Maani, 2019). Tutors usually guide their students through group and one-to-one tutorials, which occur frequently – and sometimes once or twice per week.

After each tutorial, students consider all the feedback they have received from their tutor – in addition to their own thoughts – and they continue to work on their own to develop the design

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Sub-categories</th>
<th>Number of questions/items</th>
<th>All years ($N = 615$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Learning engagement</td>
<td>(1) Ease of technology</td>
<td>3</td>
<td>3.3 0.6 48.4%</td>
</tr>
<tr>
<td></td>
<td>(2) Tutor support</td>
<td>4</td>
<td>2.9 0.5 38.6%</td>
</tr>
<tr>
<td></td>
<td>(3) Feedback</td>
<td>3</td>
<td>2.4 0.2 23.9%</td>
</tr>
<tr>
<td></td>
<td>(4) Peer learning and collaboration</td>
<td>3</td>
<td>2.1 0.4 17.1%</td>
</tr>
<tr>
<td>(2) Learning autonomy</td>
<td>(1) Responsibility</td>
<td>4</td>
<td>3.4 0.5 50.7%</td>
</tr>
<tr>
<td></td>
<td>(2) Time management and workload</td>
<td>4</td>
<td>2.3 0.4 22.6%</td>
</tr>
<tr>
<td>(3) Learning quality</td>
<td>(1) Design outcomes</td>
<td>4</td>
<td>2.8 0.5 38.5%</td>
</tr>
<tr>
<td></td>
<td>(2) Design process</td>
<td>4</td>
<td>2.5 0.3 30.3%</td>
</tr>
<tr>
<td>(4) Learning behaviour</td>
<td>(1) Sustainable practices</td>
<td>3</td>
<td>3.7 0.4 82.1%</td>
</tr>
<tr>
<td></td>
<td>(2) Use of online learning resources</td>
<td>3</td>
<td>3.3 0.3 73.0%</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
<td>3.5 77.6% 2.9 45.2%</td>
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</tbody>
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Table 2. Descriptive statistics for students’ views on the four dimensions of the online design experience during COVID-19.
work for the upcoming tutorial. The developed solution is the further discussed with the tutor, and the process of refinement and development continues until the design proposal is satisfactory. Schon (1985) analysed the design tutorial as a key interaction of the design studio, in which there is a discussion and collaboration on the design work between the student and the design tutor.

In this study, the students’ dissatisfaction with their tutors’ support was evident. Only 38.6% of the students were satisfied with the amount and form of support provided by their tutors. Graduate-stage students were the most satisfied, with positive responses from 50.3% of the group.

Almost 67.9% of the students felt that communication with their tutor was more difficult than usual, saying they feel uncomfortable communicating virtually. Over half (59.2%) of the students agreed that their tutors were flexible in terms of using any available materials for exercises and projects. However, only 30.9% felt that their tutors were happy with online teaching and able to discuss their work easily. While, this might be due to tutors’ connectivity issues, difficulties with using the new application, or unfamiliarity with working from home (especially in the presence of other family members and children), students could interpret their tutors’ discomfort as reflecting a lack of interest in their design work or a judgement that their work is of poor quality. For example, one student commented as follows:

Tutors seem like they do not care about our mental health.

Other students compared their tutors’ behaviours during the online learning period with their behaviour when teaching design on campus:

Tutors have family and kids. They do not always show on time for the studio! They’ve never done this on campus.

I think not all my tutors are able to work efficiently online. It’s obvious [this is] their first time online teaching.

Based on these results, it is clear that staff members need training and practice in the use of online software, to facilitate communication between tutors and students and ensure that tutors are providing effective support.

**Feedback**

Feedback is a major area of interest within design education. The influence of feedback on the quality of online learning has been explored in several studies; and there is strong evidence that the timely provision of constructive tutor feedback is key to the success of online courses, which affects the students’ satisfaction of their online courses (Howland and Moore, 2002; Vonderwell, 2003). When feedback was delayed, students expressed feelings of stress, frustration and confusion. Woods (2002) further emphasizes that instructor feedback in online courses is highly correlated with students’ overall satisfaction.

The results of the current study similarly indicate the importance of tutor feedback from the student point of view. When students were asked about the type of discussion they favoured, 62.7% of the respondents said that they preferred to discuss their design work with their tutor in a one-to-one discussion (see: Figure 3).

Students strongly disliked discussing their work in groups and in jury sessions, with those expressing positive responses totalling just 22.8 and 27.1%, respectively. This may be primarily due to the lack of emotional connection when working online, particularly when the camera is turned off and students cannot see the reactions of the reviewers. Graduate students recorded the highest preference for jury sessions (24.2%). This may be because graduate students would prefer to discuss their designs with professionals currently practising in the field.

The students reported very low rates (23.9%) of satisfaction with the feedback they had received. Less than a quarter of the students were happy with the amount and frequency of
feedback from their design tutors or the new assessment criteria (20.7 and 24.9%, respectively). Only 26.1% of the sample reported that their tutors gave them feedback in a timely manner.

Previous studies have shown how students feel about a lack of feedback; and many students in this study supported this finding:

The amount of feedback we’re getting is not enough.

We need to see tutor’s face. Listening to their comments without seeing them is somehow limiting our understanding of their feedback.

Design tutors have their own strategies for communicating with students. Some prefer to talk and others prefer to demonstrate. In practice, most design tutors use both showing and telling (Demirbaş and Demirkan, 2003). This interaction in the online environment is problematic, as most students (71.2%) preferred the traditional type of feedback, which is manual sketching based on face-to-face contact with the tutor. Direct modification of the software file was the preference of few students (34.7%), as this increased their reliance on the tutor and limited their role as a constructor of knowledge (see: Figure 4). Students explained that, when feedback was limited to a single form, this did not encourage them to develop their work further.

Feedback on my work was limited, my tutor only gave me verbal feedback.

The feedback is insufficient, verbally, for a second year students. We must manually amend our design...we spend our time searching for help and information from other sources.

**Peer learning and collaboration**

One-to-one tutoring feedback is essential. However, students also learn and develop various skills when they are working together in the same space, or when attending one another’s critiques.
(Crisosto et al., 2010). Such a process can improve the student’s self-confidence in their designs (Choi and Kim, 2016). In addition, students who are taught individually rather than collaboratively may fail to develop the skills they need for collaborative work (Crisosto et al., 2010).

In this study, peer learning and collaboration was investigated in terms of the effectiveness of online collaboration, the level of creativeness in team work, student preferences for meeting with peers and online collaboration tools. The students showed the lowest satisfaction with this dimension across the whole questionnaire (17.1%).

Most (91.3%) of the students preferred face-to-face meetings with their peers, rather than online meetings. Only 22.3% said they were able to collaborate effectively when working virtually. In addition, 79.5% of respondents felt that online collaboration limited the quality of the work produced by group projects. One student commented that, “We did not work efficiently as a group.”

These percentages rise up for senior stage students, who are the most concerned about group work due to the type of projects. They are more negative towards online collaboration. The following comments from the students expressed their need to interact with each other for mutual benefit, to pick up ideas and to compare themselves with their peers.

I prefer if I could see other students work, we need group tutorial and not just one-to one... so we can discuss our works.

Interestingly, more than 70% of the students (at all stages) communicated with one another using online tools other than the official tool provided by the university. Social platforms such as Facebook Messenger and WhatsApp were most often preferred for collaboration on group-work assignments, with fewer students preferring the formal tools (e.g. email, Google Docs and Skype). This is likely due to the popularity of these user-friendly social platforms.

Based on the previous results, it might be concluded that online learning is ineffective for group-work projects and the promotion of peer learning. Tutors are responsible for encouraging reflective discussion, helping students to recognize their own support networks, and providing opportunities for groups to share their values and work. The role of the tutor is limited by the online model, as illustrated previously, and this could be limiting effective collaboration between peers.

**Learning autonomy**

A central cognitive demand placed upon architecture students is the need for engagement with the uncertainty inherent in design problems (Cross, 2011). Design problems are ill-defined and ill-structured, thus it is common for students to experience a sense of being lost and uncertain. The unique nature of the design problems – and a lack of architectural knowledge – may together leave students confused about the nature of the actions they must take, causing them to feel unsupported. Moreover, the figures cited previously show that many students feel there is a lack of guidance and support in the online design studio. However, this could be seen as an opportunity to move towards greater understanding of the self as a learner of design and a driver of autonomy.

The learning of autonomy is measured in terms of students’ learning responsibility ($M = 3.4, SD = 0.5$) and workload and time management ($M = 2.3, SD = 0.4$). In this study, over the third of the sample (36.7%) described becoming more independent and responsible for their learning during the semester (see: Table 2).

**Responsibility**

Overall, the majority of the respondents indicated moderate rates of learning responsibility: 71.5% students said they attended every design studio and 63.2% thought that they had become more independent in their decision-making about their design projects. However, just 34.4% thought that their self-assessment and decision-making performance had improved, and only 33.7% said that they had achieved the learning outcomes for the design course.
Nevertheless, it is noted that the students working on their graduation projects gave higher scores for each of these items. It is expected that students in their final year will be more familiar with the design process and confident in their level of experience and confidence (Sawant et al., 2017); and, consequently, they tend to be more responsible and independent in their design decision-making.

In addition, many students (50.7%) said that online studios allowed them to discover their potential and overcome their weaknesses:

I believe I became more responsible about my design, as online learning gave us the opportunity to rely more on ourselves.

I had to develop my digital skills to work on my drawings and model, which is really a huge step for a second-year student.

**Time management and workload**
The management of workload and time was identified by the majority (77.4%) of the students as a challenge for online learning. More than three-quarters (82.1%) of the students found that online communicating required more time than the traditional design studio. In addition, 87.2% said that the rapid shift to online learning had caused dramatic changes in the way tutors evaluated their work and created additional workload. Many universities were able to move deadlines back to ease immediate pressures, giving students extra time on the original submission deadlines. This was especially common for students working on their graduation projects.

Students rated time as a challenge. This was not necessarily a lack of time, but rather difficulties in coping with the online environment and managing their time, whilst living with their families and studying from home:

Although online learning saved [the] time that we spent on transportation, but we did not know how to manage our time with moving online, especially with the new way we were assessed.

Online teaching is time-consuming, especially for those who live with their families ... I lacked motivation.

These responses suggest that students from all years have serious problems with managing their study time and planning for design tutorials and online submissions. These findings agree with those of Newman et al. (2018). Therefore, the identification of strategies to improve students’ time scheduling should be a priority to enhance the online learning experience.

**Learning quality**
Quality is key to the delivery of all effective courses and programmes, regardless of the environment in which they are delivered. Online learning environments, such as the design studio, cannot ignore either the physical (i.e. the appearance of learning resources, personnel and communication materials) or temporal student needs (i.e. a willingness to help learners and provide prompt service; Mahlangu, 2018).

Learning quality is measured by students’ satisfaction with their design outcomes (\(M = 2.8, SD = 0.5\)) and the suitability of the online studio for the different phases of the design process (\(M = 2.5, SD = 0.3\)). In this study, students’ satisfaction with online learning quality was low (34.4%); only a third (30.3%) believed that the online studio was suitable for learning and for developing all phases of the design, and 38.5% were happy about their design outcome at the end of the semester (see: Table 2).

**Design outcomes**
Achievements against learning outcomes are measured to evaluate the success of courses. In this study, online design learning outcomes were measured by focussing on students’ ability
to develop work of the same quality as expected and to develop new skills. The results show that only 38.5% of the students were satisfied with their learning and design outcomes.

Only 20.8% of the students felt that they could clearly translate and express their design ideas when working with computers and without manual drawings or physical models. Just 32% said they were able to submit design work electronically of the usual quality. In addition, 70.5% of the students reported problems with understanding the material, the requirements and the instructions. Foundation students were suffering the most in this area. Students commented as follows:

I could not acquire the needed skills... I could not finalise plans, elevations, and sections as required.

Students in the first and second year, are not familiar with using certain software to develop the work... I did not even have AutoCAD on my laptop.

One final-year student expressed concerns about the final design outcome, saying he was less confident about the work than with previous studios:

I'm worried that working on my graduation project under these circumstances might affect my opportunities [for] finding a job in few months.

Although responses in this domain were overall negative, the students did indicate that they had developed their computer skills more than they would have expected. Most (71.8%) had substantially developed their skills in Photoshop, Revit and CAD software, though less than 50% of the foundation-stage students said they had done so. The higher-stage students felt that they were more likely to have improved their computer skills because they had had more time to spend on their digital models, which had replaced the physical alternatives that they could not execute due to a lack of access to materials and the school workshop.

**Design process**

Only 30.3% of the students found the online design studio useful for the different stages of the design project (research and analysis, concept development, architectural drawings, juries and reviews). The final year students were most likely to feel positively about the usefulness of the online course (44.5%). This may be due to their design experience, high-level software skills, confidence and relatively lower workload.

Students cited many reasons, including a lack of software skills and insufficient knowledge of the project site:

I could not visit the site... I think my understanding of the project is somehow limited because it’s based only on Google Maps.

Moreover, less than 28% of the students were satisfied with processing juries and reviews. Critique sessions are well-known to be stressful for students in a face-to-face environment, and they are considered more difficult on an online environment. However, George and Walker (2017) found that both students and reviewers worried about critiquing design work through a virtual medium – due to emotional and social factors, rather than technology issues. Some students talked about how difficult it was to understand some comments during the review, finding they were unable to learn from the verbal feedback without seeing the reviewer’s face:

We need to see the reviewer’s face. Hearing their comments without seeing them is uncomfortable.

**Learning behaviour**

The universities’ shift to online learning has caused changes in learning behaviour. This study categorised these changes into two practices: the reduction and reuse of material (sustainable practices) ($M = 3.7$, $SD = 0.4$) and the greater reliance on online resources to
support learning and understanding ($M = 3.3$, $SD = 0.3$). The results show the highest levels of student satisfaction in the domain of learning behaviour (77.6%; see: Table 2).

Students cited numerous advantages of online learning in this area, and many suggested continuing to utilise digital models to reduce both the cost of printing and the impact on the environment:

I can spot a good thing here: we saved a lot of money off printing and not making physical models with expensive materials . . . we made digital models and our physical models were made out of recycled materials. If this worked successfully during corona, then we might consider it for future design studios.

Sustainable practices

The area of sustainable practices was the only aspect considered to have been positively affected by the move to online learning. Students from different universities have had to lean more heavily on digital models to explore, interrogate and represent their work, which was negatively perceived by first- and second-year students.

On average, 75% of students at the different stages had improved their use of sustainable practices. They reported planning in advance how to use paper and cardboard in the most beneficial ways; using and reusing both sides of the paper and recycling cards, folders, boxes and envelopes to make physical models. The foundation-stage students showed the highest tendency to reduce, reuse and recycle materials (more than 90%), as projects in this stage are based on modelling and manual drawings. The higher stage students showed the opposite, with a greater tendency to develop computer skills than to reduce and reuse. These practices could contribute to the reduction of energy emissions.

It is argued that there is a direct link between education and sustainable practice, with higher education tending to promote the latter. An implementation plan to promote sustainable action could support the transition towards a more sustainable university (Alnusairat et al., 2020). Accordingly, the online design studio could enhance the intention of students to develop a transformative approach to sustainability, by eliminating the requirements of paper for drawings and materials for physical models. Furthermore, online learning includes a reduction in the need for travel and the elimination of energy-consumption for campus site utilisation. This amounts to 87% less energy and 85% lower CO$_2$ emissions, compared to traditional full-time campus-based courses (Disterheft et al., 2016).

Use of online learning resources

Students showed a high tendency to use online resources, and approximately 73% of the sample were satisfied. The majority (65.8%) found the learning resources for their assignments to be easily accessible over the Internet, students at the senior and graduate stages being particularly positive. Approximately 76% of the sample spent more time watching YouTube learning videos or reading architectural blogs than usual due to availability of resources. However, senior students (year 4) were the least likely to be satisfied (<68%). This may be due to the nature of their exercises, which require collaboration between peers. Over 77% of the students said that they would be more satisfied if they had access to the resources of other design studios. Foundation students expressed the strongest agreement with this statement (>85%). Such engagement between different classes of design studio can create benefits for the learning process, enabling transparency, knowledge collaboration, a shared understanding and open perspectives (Clarvis et al., 2015). One student commented on this:

We need to be provided with more online resources.

It is possible to create a virtual exhibition of students’ work and publish the distinguished projects in a special page or website for each faculty of architecture in Jordanian universities.
Students’ reflections

Three questions were added to the end of the survey to invite the students’ insights into their online learning experiences during the period of quarantine. Students’ reflections concerned the impact of the online studios on their physical health (\(M = 1.9, SD = 0.3\)), the impact of the quarantine on the online studio (\(M = 2.2, SD = 0.3\)) and their overall satisfaction with the experience (\(M = 2.1, SD = 0.4\)).

In this study, the students’ overall satisfaction with the online learning experience was low (22.5%) and 84.9% of the sample said that the online studio had had a negative impact on their engagement in physical activity. A large majority (80.8%) thought that the lockdown as a whole had reduced the quality potential of the online design studio. The students’ feedback included the following remarks:

Maybe online education is better, but not in time of lockdown that we are experiencing now. We sit at home, but with no real achievements; perhaps due to the laziness of the student, as we are surrounded by four walls without any type of recreational activities, as in normal days.

Just 33.2% of students said that they would consider taking another online design studio in the future. However, acceptance and satisfaction with the experience of the online design studio increased with the level of study: 21.2% (year 1), 26.7%, 35.2%, 31.5% and 51.5% (year 5). Only 24% of students in the beginning and foundation stages would consider taking another online design studio in the future, while the percentage doubled for graduate-stage students (see: Figure 5). The low percentage (31.5%) for the senior stage could be due to the previous finding that online collaboration between peers was ineffective, thus limiting the quality of work. However, future experiences of online design studios could be less challenging for students, enhancing their collaborative thinking about architectural problems (Mulligan et al., 2018). One student commented as follows:

We are struggling with group work because we cannot meet together.

Further analysis of the results revealed that the number of male students who would consider taking another online design studio was more than 10% higher than the number of female students.

At the end of the questionnaire, students were asked to share their final remarks on improving the experience of the online design studio. These responses were analysed in relation to the primary dimensions of the study (see: Figure 6). In general, more than 75% of the students described a need to improve learning engagement, with a focus on the parameters of technology, tutor support and feedback. More than 25% of the students said that improved tutor support would benefit the online design studio experience. They recommended that tutors better...
support student learning by being friendlier and closer to the students, showing understanding of the unique circumstances, and allowing students to feel more comfortable with them.

The need for user-friendly technology was also highlighted, with an emphasis on applications being sufficiently flexible to be run on various devices (e.g. mobiles, tablets, laptops and desktop computers) and on Internet connection quality. Moreover, students cited the importance of improving software skills before beginning the online design class so they could better translate their designs to the computer (away from manual drawings and physical models). In addition, this would help to ensure that their submitted design work was of the same quality as their usual design studio work. The students also mentioned that the instructors of the online design classes needed to improve their own software skills to enable them to provide efficient feedback and more effectively explain the requirements. A third (35%) of the students thought that enhancing the feedback process for their design work would improve the online design class experience. This should include increasing the frequency of feedback, using manual sketches, conducting one-to-one discussions between the instructor and the student, and explaining the grading system.

A third (33%) of the students acknowledged a need to learn greater autonomy, including time and workload management and self-assessment skills. The students recommended that workload of the online design class should be less. In addition, before starting such a class, students should receive support in effective time management. Senior students were the most positive about this category, with more than 52% citing its importance – particularly in terms of workload. This may be due to the nature of the design project at this stage, which requires group work.

**Conclusion**

The findings of this study highlight that many of the participants felt uncertain about aspects of their online learning experience and wanted more guidance and support. Encouragement and direct guidance were vital during the first year. Moreover, students lacked time- and workload-management skills, relied on grades to evaluate their learning (in place of self-assessment skills) and needed their tutors to provide the teaching.

There are many reasons why students may felt unsupported and consequently become disengaged from the online design studio experience. These include technical factors (such as poor network quality and lack of familiarity with the new applications). Students and tutors’ personal situations when working and studying from home are also relevant, as are the tutors’ lack of expertise in online teaching and the limitations on peer interaction. Together, these factors can make the experience of the online design studio more challenging.
Thus, design tutors should work to expand their students’ understanding by explaining at the beginning of the year what is meant by online learning in a design studio environment. This will enable students to think more independently and gradually adopt the new model of student-centred learning. Tutors should also explain how the students will be assessed, and demonstrate the requirements and responsibilities expected of them. Tutors should allow their students to attend other students’ sections and see their work throughout the year and arrange group tutorials and critiques with them.

This study employs a mixed method approach, which has the advantage of enabling deeper insights of the topic, but the sample is limited. Specifically, it comprises students in one country with an imbalanced gender ratio. As a result, the findings of this study are less generalisable to other institutions and student groups.

Thus, a study focussing on conceptions of online learning and how they differ between genders would expand our knowledge of the topic. Finally, a follow-up research with the same students, conducted towards the end of the following semester of the study, would provide further insights into long-term experience of online learning, including how this develops and at what areas.

References


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