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# Design studio in a challenging period: Implications for a digitalized education

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## Abstract

The unexpected and extensive emergency caused by the Covid-19 pandemic between 2020-2022 created a test environment that incorporates valuable data for the digitalization of education. Using the data obtained from architecture and interior architecture students, this research focuses on one of the fundamental elements of architectural education, the design studio. Examining online design studio (ODS) students from three different schools of architecture, this research tries to identify the technical resources utilized, students' social interactions, physical and emotional wellbeing, and how these factors and demographic variables effected their ODS evaluations. The findings acquired by both qualitative and quantitative methods show significant relations between the technical resources of the students with their overall satisfaction from the ODS experience, as well as the level of their social interactions, physical, and emotional status. While ease of reaching resources, watching recorded lectures and critics, presenting student projects digitally both for critics and juries are strengths of the ODS, technical challenges for digital sketching and differing social requirements depending on the student's year of study (YofS) are observed as weaknesses. Although the research has substantial limitations, the findings are proposed to be valuable for the research on developing a digital design studio.

## Highlights

- First-year students are less satisfied with the ODS due to design studio adaptation problems, lack of peer and instructor interaction.
- Fourth-year students are more satisfied with the ODS and eager to retain the ODS setting in the future. Male students feel an increased sense of belonging for their institutions, while female students feel more mixed emotions.
- Sketching using mouse or trackpad is the biggest technical challenge of ODS. ODS period is a rich source of data for research on the digitalization of architectural design studio.

## Keywords

Architecture; Covid-19; Information technologies; ICT; Online design studio

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# Zorlu bir dönemde tasarım stüdyosu: Sayısal eğitim için çıkarımlar

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## Anahtar Sözcükler

Mimarlık; Covid-19; Bilgi ve iletişim teknolojileri; BİT; Çevrimiçi tasarım stüdyosu

## Öz

Covid-19 salgının 2020-2022 yılları arasında neden olduğu ani ve geniş çaplı acil durum ortamı eğitimin sayısallaştırılmasına yönelik pek çok verinin elde edilebildiği deneysel bir ortam yaratmıştır. Mimarlık ve İç Mimarlık bölümü öğrencilerinden elde edilen verileri kullanan bu araştırma, mimarlık eğitiminin temel yapıtaşlarından birisini oluşturan tasarım stüdyosuna odaklanmaktadır. Üç farklı mimarlık fakültesinin çevrimiçi tasarım stüdyosu öğrencileri ele alınarak, kullanılan teknik ekipman, öğrencilerin sosyal etkileşimleri, fiziksel ve ruhsal iyilik durumları ve bu etkenlerle demografik değişkenlerin çevrimiçi tasarım stüdyosu deneyimlerini nasıl etkilediğinin ortaya konması amaçlanmıştır. Nicel ve nitel yöntemler kullanılarak elde edilen sonuçlar öğrencilerin kullandıkları teknik ekipmanla çevrimiçi tasarım stüdyosu memnuniyetleri, sosyal etkileşimleri, fiziksel ve ruhsal iyilik durumları arasında bağlantı olduğunu göstermektedir. Ders kaynaklarına erişim, stüdyo kayıtları ve kritiklerin tekrar izlenebilirliği, jüri ve kritiklerin sayısal ortamda yapılmasının olumlu etkileri çevrimiçi tasarım stüdyosunun güçlü yönlerini oluştururken, sayısal ortamda eskiz ve çizim yapmanın zorluğu ve öğrencinin kaçıncı sınıfta olduğuna bağlı olarak değişkenlik gösteren sosyal gereksinimler çevrimiçi tasarım stüdyosunun zayıflıkları olarak tespit edilmiştir. Araştırmanın belli kısıtları olsa da bulguların sayısal tasarım stüdyosu derslerinin geliştirilmesi konusundaki araştırmalara katkı sunması beklenmektedir.

## Öne Çıkanlar

- Birinci sınıftaki öğrencilerin çevrimiçi tasarım stüdyosu memnuniyeti, stüdyo adaptasyonu, akran ve eğitmen etkileşimi sorunları nedeniyle daha düşüktür.
- Dördüncü sınıf öğrencileri, çevrimiçi tasarım stüdyosundan daha memnun oldukları gibi bu sürecin devam etmesini de en çok isteyen gruptur.
- Çevrimiçi tasarım stüdyosu erkek öğrencilerin kurumsal aidiyetine olumlu yönde etki ederken kadın öğrenciler daha karmaşık bir duygu durumu içerisinde olduklarını belirtmektedir.
- Çevrimiçi tasarım stüdyosunun teknik açıdan en olumsuz yönü fare ya da dokunmatik yüzey (ing:touchpad) kullanarak çizim yapmak olarak ortaya çıkmaktadır.

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## INTRODUCTION

The pandemic caused by the coronavirus disease of 2019 (COVID-19) gripped the world in the early days of 2020, and paralyzed social, economic, and educational activities around the globe. This period tested the 'resilience' of the education system explicitly (Dinç Uyaroğlu, 2021), and revealed the necessity of thinking more on the sustainability and resilience of architectural education. As part of emergency measures in many countries across the globe, higher education institutes are enforced to cancel all conventional face-to-face teaching activities and offer online classrooms. In most cases, both educators and students with different levels of digital literacy had to deal with minimum resources, new applications (Charters & Murphy, 2021), limited guidance (Alnusairat et al., 2021) and a different spatial setting: their home environment, which is not specifically designated for teaching or learning. The distress caused by the pandemic is not limited by these challenges. The need for new teaching and learning strategies emerged (Milovanović et al., 2020), especially for practical courses (Dinç Uyaroğlu, 2021).

The earliest research studies focused on the transition period of the 2019-2020 spring semester, where classes started face-to-face and then turned into online ones (Alnusairat et al., 2021; Ceylan et al., 2021; Dinç Uyaroğlu, 2021; Iranmanesh & Onur, 2021). As the nature of this transition semester was an emergency, the efforts and motivation can be considered as being based on completing an unfinished mission. However, the prolonged presence of online semesters following each other, turned the emergency into a 'new normal', which challenged the mixed emotional state of educators and students even further. In order to understand the consequences of such a situation and help ensure the sustainability of architectural education, it is important to explore the pandemic period from a more holistic perspective. Evaluations concerning this period is still scarce in literature (Levent Kasap, 2023).

By aiming design studio students, and capturing three semesters until the end of 2020-2021 spring semester, this paper tries to identify technical difficulties students experienced and their physical, and emotional status in this extended time frame. This study claims that the online design studio (ODS) experience under the emergency will contribute further development of distance education procedures and the use of information and communication technologies (ICT) in design studio education. Regarding that, a survey is conducted to assess the technical resources of architecture and interior architecture students, their performance and interest towards design studio courses, and their physical and mental wellbeing during the semesters seized by the pandemic. The research

questions are formed on the student satisfaction from the ODS setup in relation with their technical resources, physical and emotional experiences, and demographics.

Next section introduces the challenges of both the conventional design studio and how that conventional education method is confronted during the emergency, leading the path to the research questions. After the methodology section, findings of the survey are presented, and the research questions are evaluated and discussed in the fifth section, followed by the conclusion.

## DESIGN STUDIO AND ITS CHALLENGES

### The Conventional Design Studio

Studio and studio pedagogy have been central to art and design education for over two centuries and the general characteristics are affiliated with ateliers of the Ecole Des Beaux Arts and a relatively new studio model of the Bauhaus (Broadfoot & Bennett, 2003). Design studios and its culture is one of the fundamental themes in design education (Hacıhasanoğlu, 2019). The purpose of the design studio is to support students in generating design ideas and content creation based on analysis and critical synthesis (Hassanpour & Şahin, 2021). Various types of learning activities, such as lectures, group work, one-on-one consultations, and critiques take place in design studios (Masdéu & Fuses, 2017; Yu et al., 2021). Design studios take part in design education curriculum as a social learning environment where students have one-on-one interaction with instructors and their peers (Ahmad et al., 2020; Ceylan et al., 2021; Charters & Murphy, 2021; Hacıhasanoğlu, 2019), forming a sense of belonging that enables collaborative problem solving. These interactions exceed even after the course hours (Alnusairat et al., 2021). This relationship between the student and the instructor, which is frequently mentioned as master and student model (Brzezicki, 2020), also helps students develop hand-drawing skills and learn technical drawing, which is a vital communication language for AEC industry. This connection becomes more important where students are not required to have drawing abilities for applying design-oriented departments, such as in Turkey (Akçay Kavakoğlu et al., 2021). The design skills and fundamental acquisitions acquired in these studios influence the design approach of the students (Kararmaz & Ciravoğlu, 2017) and places design studio at the heart of architectural education.

### ODS as an Educational Approach

Parallel to the advancements in ICT, number of online degree programs and online courses have increased around 50% in the last decade, all over the world (Fleischmann, 2020) and virtual design studios are also undertaken in the architectural pedagogy for more than two decades (Ahmad et al., 2020). However, undergraduate level design degree courses offered online are still rare (Fleischmann, 2020), and the main reason seems that, the design studio culture does not quite fit into the online education concept, yet. The reason for this maladaptation lies under the special characteristics of the design studio, such as peer interaction and collaborative work, instant feedback based on instructor's one-on-one critiques, and spatial characteristics of the studio environment. Moreover, there are research findings reporting possible demographic issues that should be addressed such as male students performing better in technology-based courses (Demirbas & Demirkan, 2007).

There are other educational models like hybrid or blended learning and flip classroom that are intended to integrate technology and even social media applications and move some of the learning activities outside the classroom. These methods can also be praised as an alternative (Yazıcıoğlu Halu & Kula Say, 2021), as the next step towards digitalization after the so-called new normal. However, it is still being argued that dialogical learning and teaching methods of design studio cannot easily be transferred into online learning (Fleischmann, 2020).

**Online Studio as an Emergency Toolkit**

Consequently, problems encountered during distance education and online courses were not a new phenomenon when the unexpected Covid-19 outbreak brought face-to-face education systems to a halt. According to the United Nations (UN), 1.5 billion students in 165 countries were out of school and the new methods of distance education caused challenges of emotional, physical and economic difficulties for both educators and students (UNAI, 2020). Early research addresses (1)higher rates of anxiety, depression and stress related issues in art students (Asadpour, 2019), (2)loss of physical, material and social aspects of learning within the studio (Charters & Murphy, 2021), (3) less successful hand-drawn graphic communication skills (Iranmanesh & Onur, 2021; Yu et al., 2021), (4) problems the students face with the internet and electrical infrastructure as well as digital and technological equipment (Şekercï et al., 2021), (5) difficulties arising from students' private work environment (Marshalsey, 2021), (6) alienation towards the architectural profession (Ceylan et al., 2021), (7) 'ghost' students hiding behind the closed cameras, and inequalities caused by the economic and physical conditions of the students (IZTECH, 2021). Marshalsey also points out a different level of response depending on the students' year of study: "*Students who were situated in the later years of their degree programmes fared better than first year students new to the processes, practices and socialisation of studio learning*", but does not provide further justification (Marshalsey, 2021).

Despite these ODS problems, Şekerci etal. state that three fifth of the students, and one third of the instructors are thinking positive about online courses (Şekercï et al., 2021). Some of the remarkable benefits of the online education, detected in this emergency period are asynchronous lectures recorded on the cloud drives enabling students to catch what they missed during the class hours (Ceylan et al., 2021; Charters & Murphy, 2021), availability to follow the critiques that others receive during the classes as well as at the juries, and having more control over what is being presented at any particular moment in the juries (Iranmanesh & Onur, 2021).

It is possible to see this period generating an experimental opportunity that will accelerate the process to solve the problems of online education and help to enable the digitalization of studio education (Kasalı et al., 2020). Thus, under the light of these initial studies, this research tries to examine the socio-economic, physical, and emotional challenges faced by the students and their ODS satisfaction. Consequently, the research questions of this study are revealed as:

(RQ1) 'Is there a relationship between students' ODS satisfaction with the infrastructure and equipment that students have?',

(RQ2) 'Is there a relationship between ODS satisfaction with their social interactions and emotional experiences?',

(RQ3) 'Is there a relationship between students' demographic profile with their online studio satisfaction, social and emotional experiences, and emotional status?',

during the pandemic entailed online studio education.

# METHODOLOGY

## Study Instrument

An online survey is conducted in order to collect data. Survey questions cover four main question groups as follows: (1) the software and hardware they utilized during the ODS lectures, (2) the number of online and face-to-face classes they enrolled, the teaching methods used and their satisfaction level from the ODS setting, (3) students' physical and mental wellbeing and their daily life experiences during this new setting in the pandemic era, (4)demographic questions pertaining students' age, gender, university/department and the year of study (YofS). The survey ended with an open ended question for remarks that students would like to add for the ODS process they encountered.

The survey was prepared on a dedicated website and the link of the online questionnaire was sent to the students by e-mail in February 2022 with an explanatory text about the research aims. Moreover, a cover letter was placed at the welcome page of the given link, referring to the details of the research and how the data gathered from the survey will be used. The cover letter ended with a request for the consent of the participants. The survey duration was limited by 3 weeks. During this period two separate e-mails with the same questionnaire link were sent as a reminder and increase involvement.

## Sampling, Participants and Data Analysis

The survey universe of this research is design studio students of architecture and interior architecture departments. Three different universities located in Istanbul, Turkey are selected depending on the availability of a contact person to conduct the survey. Two of these universities, Altınbaş University and Istanbul Aydın University are private universities, and Istanbul Technical University is a state university.

E-mails of the survey were sent to a total of 355 architecture and interior architecture students in total and received 141 responses. Between these, 4 responses did not have sufficient number of questions answered so they are excluded (N:137). With 137 valid answers from the total number of 355 e-mailed students, the valid response rate of the questionnaire is calculated as 38,6%. This rate of response represents enough sample size for a confidence level of 95% and a margin of error less than ±6,6%, with a sample proportion of 50%. So, mean values retrieved from the survey data should be considered within a confidence interval of ±6,6%.

Teaching related student evaluations tend to have much lower response rates, especially when they are conducted online (James et al., 2015). Although 5% is accepted as the common value for margin of error at the 95% confidence interval, the margin of error in social science research generally ranges from 3% and 7% and depends to the sample size (NIH, 2005). Therefore, even though the

margin of error is above 5%, statistical analysis and evaluations are still considered to be valuable for architectural education. Yet, the survey sample size is one of the limitations of the research. MS Excel and SPSS are used for statistical calculations.

### Limitations

Number of universities conducted and number of students reached is the main limitation of this research. However, it should be noted that the research is conducted in a limited period with unique environmental conditions. Furthermore, the likely differences between the design studio practices of the studied institutions are exempted from the scope of this research. This exemption depends on the complexity of the required details for making such educational comparisons, and therefore such an evaluation should be subject to further research tackling the educational framework comprehensively.

## FINDINGS

Descriptive analysis of the survey data is documented according to the group of questions under the five main topics mentioned in the methodology part. Analysis of the three research questions using the findings from the survey data follows the descriptive analysis with relevant statistical test results.

### Demographic Data

Gender of the participants are 40.9% male (N:56) and 57,7% female (N:79), while 1,5% did not prefer to answer the question (N:2). Among the respondents, 82,5% are architecture, and 17,5% are interior architecture students. Most of the students are in their third YofS with a rate of 27%. However, the second and first-year students have a similar percentage with 26,3% and 25,5% of the respondents, respectively. Finally, fourth-year students are 20,4%.

Age of the students range between 18 to 30 years (men: M=22.4, SD=1.74 and women: M=22.4, SD = 2.00). The median age of our sample is 21 and mean age of the respondents are 22.7. The majority of the students (77,3%) are between 21 and 24 years of age. 21 has the highest rate of 22,6%. Second and third highest ages are 22 and 23, with a response rate of 21,9% and 19,7% respectively. Most senior age is declared as 30 by 1 student and 3 of the students did not answer this question.

### Utilized Equipment and Software

More than seventy-two percent of the students (72,1%) use laptop computers, with an additional 8,8% who frequently use this type of hardware for their ODS setup. With these two scores, relatively strong responses reach to a total of 80,9%. Second most recurrently used hardware is smartphone with answers of 18,7% for ‘used for every course’, and 12,2% for ‘used frequently’. Tablet computers stayed at the last row with 4,2% and 3,4% for the same answers respectively. In addition, 29,9% of the students answered ‘yes’ to the question if they had a printer to have print outs when necessary. while 69,3% did not have this option.

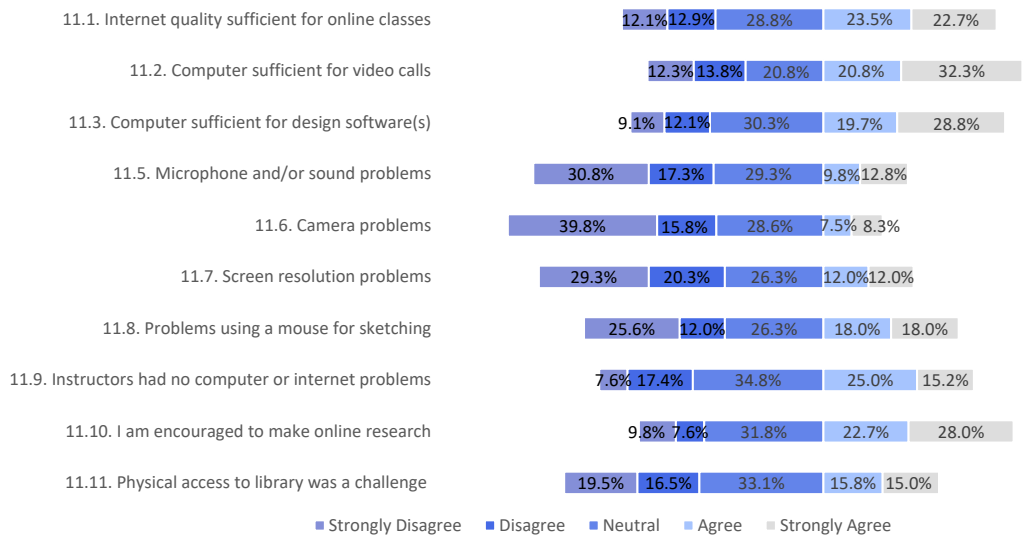


**Figure 1- Level of agreement with the statements about online education setup (Question 11)**

Answers for the first question set about the students' online education setup is shown in Figure 1. According to these responses, only two statements are evaluated with an agreement rate over 50%. With 53,1%, students agreed that their computers were sufficient enough for the video calls of the online classes, and with 50,7%, students stated that they were encouraged to make online research in this new classroom setting. Agreement for satisfaction from their computer hardware, for using the necessary design software during the online classes is 48,5%, and satisfaction from their internet connection is 46,2%. Microphone or sound, camera, and screen resolution problems are stated as 22,6%, 15,8%, and 24% respectively. Students who reported difficulty using mouse for sketching is 36%. Moreover, 40,2% of the students stated that instructors did not have any hardware or internet connection problems.

## Evaluation of the ODS Setting

Another question set (Question 10) tackled with the students' evaluation of and expectations from their ODS experience. Students were asked about their level of agreement, according to a 5-point Likert scale: (1) Strongly Disagree (2) Disagree, (3) Neutral, (4) Agree, and (5) Strongly Agree. The most powerful agreement is on the statement for 'watching online course recordings help improve my studio work' (57,5%), followed by 'I can easily ask questions whenever I need during the online courses' (51,9%), and 'I had/or am expecting a higher GPA during the online education' (44,7%) (Figure 2). These level of agreements are followed by 'Instructors' on-screen critics in design studio courses were more efficient than the table critics at the classroom' (43,9%), 'I had no difficulty in understanding instructions/critics given by the instructors during the online courses' (43,2%) and 'My attendance to the courses increased' (41,8%). There is also an agreement on 'Seeing all other students' work on screen improves my design projects' by 41,4%.

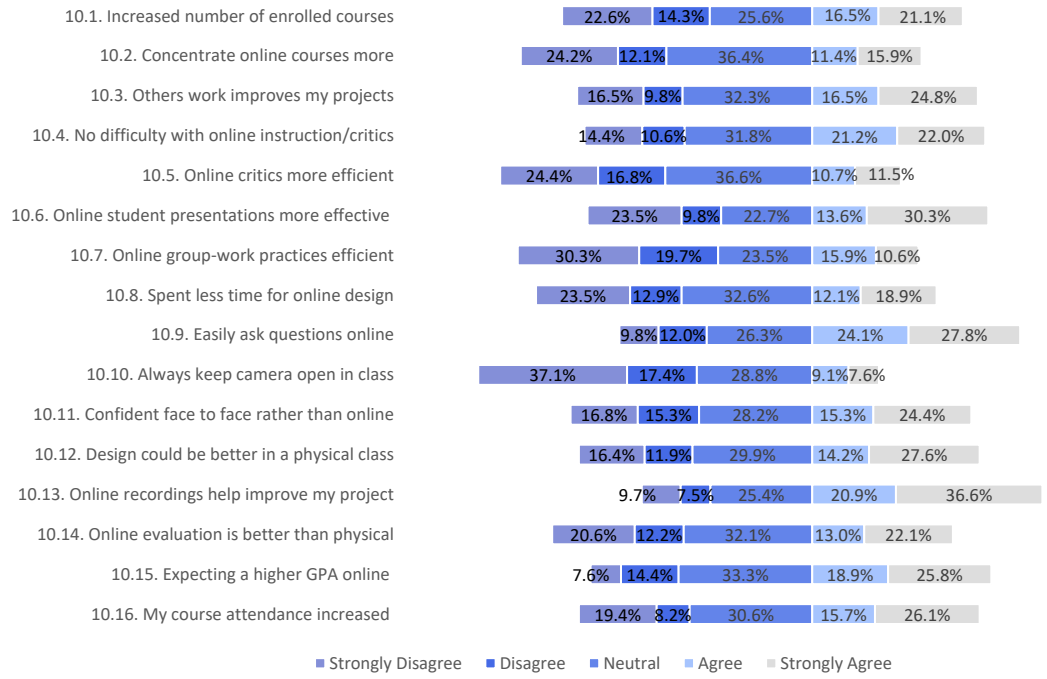


**Figure 2 - Level of agreement with the statements about online education course experience (Question 10)**

On the contrary, the most powerful disagreements are on statements 'I always keep my camera open during the online courses' (54,5%), 'Online group-work practices are as efficient as physical classroom practices' (50%), and 'Instructors' on-screen critics in design studio courses were more efficient than the table critics at the classroom' (41,2%). Students stated that they are encouraged to make online research (50,8%) and they had more time for software training and practice (54,5%).

## Social Interactions and Emotional Experiences

Participants were asked to identify the change in their social life, expectations, and their personal experiences about the pandemic in the researched period. Students who stated that they had no issues with the COVID -19 pandemic so far accounted for the 53,3% of the respondents. However, 13,1% indicated that they have recovered from the infection, while 27,7% stated that some of their family members or close relatives had issues with the viral infection.

Respondents expressed their emotional status by question 12, evaluating their agreement on given statements, with a 5-point Likert scale: (1) for Strongly Disagree to (5) for 'Strongly Agree', and (3) Neutral. Shown in Figure 3, the statements show that more than half of the students are missing both university's work environment (52,6%) and campus social life (51,4%). Students who feel as tired as a regular school day at home are 45,6%, and students who occasionally change their sleepwear during the day are 54,1%, giving clues about a possible path through depression.

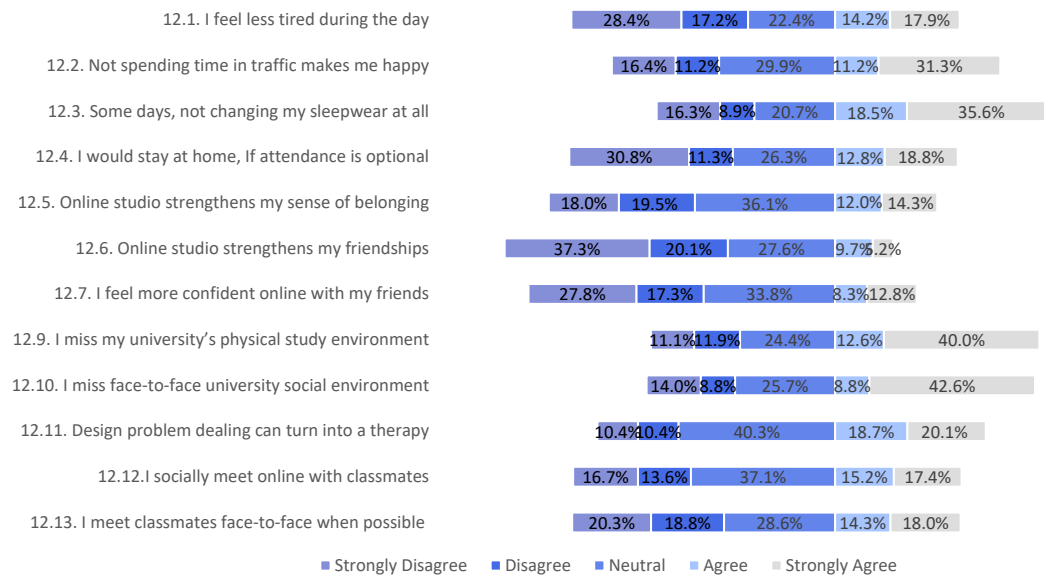


**Figure 3 - Level of agreement for the changes students have experienced in their daily life. (Question 12)**

Question 17 examined students' emotional status evaluations with the same Likert scale. Answers show that, 33% of the students approve the statement 'I don't feel good at all', and %36 admits that they had nervous breakdowns from time to time. The percentage of the students who were not feeling themselves as powerful as before is 44%. Respondents who supported the expression, that they 'miss the university campus' is 58% and 54% approved the statement that they had 'mixed feelings' (Figure 4).

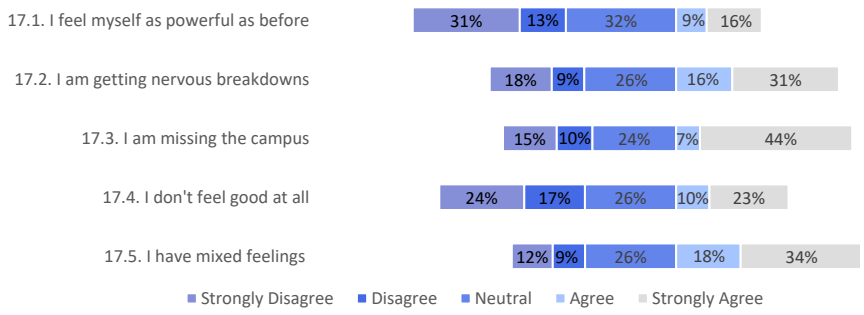


**Figure 4 - Level of agreement with the statements about student's emotional experience (Question 17)**

## Student Comments for Online Design Studio

Students who answered the open ended question to express their additional remarks about the ODS corresponds to 16%. While some students used this space to express their thanks asking their opinion, others preferred to express themselves more straight forward. Some of them expressed their feelings for going back to the campus and face-to-face education as soon as possible with remarks emphasizing the physical and emotional challenges they faced in their at-home work environment. Meanwhile, there were students who felt positive effects of the online classes, but complained about low motivation and missing social relations while some students were asking the online classes to go on, accentuating progressive sides of online education tool and methods.

Positive comments for keeping the ODS further included: "*watch*(ing) *critics again and again"* (Student 121)*, full use of time, constant focus, and benefit from colleagues' projects."* (Student 56), having "*more time to learn programs and work on the project"* (Student 85), "*saving time"* (Student 99) "…*at least 6 hours per day"* (Student 63).

On the other side, some comments included physical discomfort such as "…*damage in neck, back and palm of the hand"* (Student 31) because of staying motionless during long hours of online lectures followed by assignments. In others, psychological challenges were reported in connection with social barriers: "… *being at home all this time affected my mental health severely"* (Student 65), *"…university without leaving home wasn't good for our mental health and … our human relations. I couldn't socialize"* (Student 85), "*because humans are social creatures and they need human connection."* (Student 65). Students also mentioned the change in the educational methods and the loss of peer and instructor interaction: "*we* (should) *do* (the design studio) *with friends and in front of the teacher, but it became remote, we work on projects alone and make a lot of mistakes"* (Student 118). Returning to the conventional design studio setting was considered "…*best for students and the instructors to have face-to-face classes."* (Student 23) by some students who "…*miss these face-to-face lessons and contact with each other"* (Student 77).

Moreover, one of the student's remarks were quite intriguing and summarizing the debate: *"Online courses (are) a two edged sword, you can either learn from it and develop yourself … or just make it … an excuse for being lazy or delinquent."* (Student 4). There were also complaints issued by students. Two students mentioned communication problems with the lecturers and one student criticized connection problems they have with new to the faculty lecturers who met the students just online. These student comments are used to support the evaluation of the research questions in the following sections.

**Evaluation of Research Question 1**

In order to test the first research question of the study "RQ1: Is there a relationship between students' ODS satisfaction, with the infrastructure and equipment that students have?", a correlation test is conducted. According to the test, there is a significant relation between internet quality and computer capability that students use during the classes, with their satisfaction levels for ODS setting, at a significance level of 0,01. At this significance level, all questions except 10.1 (10.2-9, 10.12-16, and 12.4), that ask student satisfaction according to the a 5-point Likert scale, show at least one significant Pearson's Correlation value ($\rho > 0.3$, $p = 0.001$) when their relation is analyzed with 3 hardware questions (11.1-3). Variables with at least one significant Pearson's Correlation value $\rho > 0.4$ ($p = 0.001$) are shown on Table 1, in order to avoid distraction.

Students' approval for these statements are related to their hardware performance. Students who do not report problems about their computers and internet connection are over 74%, with an average of 75,9% in related 3 questions (11.1-3). These students are more satisfied with the ODS setup. These students concentrate on ODS more, following other's project on screen improves their projects, they find online critics, group work and presenting their work more efficient than the face-to-face classrooms. They are happy with course recordings and online juries. Besides, microphone, sound and camera problems do not seem to effect students' approach towards the online classes.

**Table 1 – Pearson's correlation values for hardware performance and online course satisfaction (shortened table of Pearson's Correlation (ρ > 0.4, p = 0.001)**

| | | 11. 1. Internet quality sufficient for online | 11. 2. No problem with online video calls | 11. 3. Computer sufficient for software | 11. 5. Mic. and/or sound problems | 11. 6. Camera problems | 11. 7. Screen resolution problems | 11. 8. Using mouse for sketching problems |
|---|---|---|---|---|---|---|---|---|
| 10.3. Seeing other students' work improves my projects | Pearson Corr. | .426** | .457** | .417** | 0,056 | 0,048 | -0,030 | -0,035 |
| | Sig. (2-tailed) | 0,000 | 0,000 | 0,000 | 0,517 | 0,583 | 0,730 | 0,687 |
| | N | 131 | 130 | 131 | 131 | 131 | 131 | 132 |
| 10.4. No difficulty with online instructions/critics | Pearson Corr. | .426** | .434** | .392** | 0,082 | 0,086 | 0,063 | 0,056 |
| | Sig. (2-tailed) | 0,000 | 0,000 | 0,000 | 0,347 | 0,325 | 0,470 | 0,520 |
| | N | 131 | 129 | 130 | 132 | 132 | 132 | 131 |
| 10.7. Online group-work practices efficient | Pearson Corr. | .463** | .312** | .279** | .268** | .330** | .183* | 0,130 |
| | Sig. (2-tailed) | 0,000 | 0,000 | 0,001 | 0,002 | 0,000 | 0,034 | 0,133 |
| | N | 132 | 130 | 131 | 132 | 132 | 132 | 132 |
| 10.8. Spent less time for online design | Pearson Corr. | .410** | .341** | .332** | .202* | 0,154 | 0,101 | 0,081 |
| | Sig. (2-tailed) | 0,000 | 0,000 | 0,000 | 0,019 | 0,075 | 0,245 | 0,354 |
| | N | 132 | 130 | 131 | 132 | 132 | 132 | 132 |
| 10.9. I can easily ask questions online | Pearson Corr. | .503** | .426** | .445** | 0,123 | 0,078 | 0,142 | 0,136 |
| | Sig. (2-tailed) | 0,000 | 0,000 | 0,000 | 0,156 | 0,371 | 0,101 | 0,118 |
| | N | 132 | 130 | 131 | 132 | 132 | 132 | 133 |
| 10.12. Design could have been of better in a physical classroom | Pearson Corr. | .245** | .288** | .307** | 0,131 | 0,101 | .224** | .467** |
| | Sig. (2-tailed) | 0,004 | 0,001 | 0,000 | 0,132 | 0,245 | 0,009 | 0,000 |
| | N | 132 | 130 | 131 | 133 | 133 | 133 | 132 |
| 10.13. Watching online recordings help improve my work | Pearson Corr. | .552** | .406** | .423** | 0,058 | 0,106 | 0,068 | 0,068 |
| | Sig. (2-tailed) | 0,000 | 0,000 | 0,000 | 0,505 | 0,224 | 0,436 | 0,432 |
| | N | 132 | 130 | 132 | 133 | 133 | 133 | 132 |
| 10.16. My attendance increased | Pearson Corr. | .393** | .412** | .329** | 0,026 | 0,115 | .171* | .213* |
| | Sig. (2-tailed) | 0,000 | 0,000 | 0,000 | 0,768 | 0,186 | 0,049 | 0,014 |
| | N | 132 | 130 | 131 | 133 | 133 | 133 | 133 |

**. Correlation is significant at the 0.01 level (2-tailed)

However, 36% of the students were encountering mouse or trackpad problems during sketching. Indicated problems with 'using a mouse for sketching' show a significant correlation ($r$ (132) = .467, $p < .001$), with the question 10.12 'My design studio projects could have been better if it had been carried out conventionally at a physical classroom'. This statistical relationship points out a state of dissatisfaction from the ODS and demand towards face-to-face studio setting, when students have to make sketches using a mouse or trackpad. Although student comments in the open-ended question does not give much clues on technical problems, findings show significant relationships for the RQ1, and the null hypothesis is rejected.

## Evaluation of Research Question 2

For the second research question, "RQ2: Is there a relationship between ODS satisfaction with their social interactions and emotional experiences?", the question set used for evaluating RQ1 (10.1-9, 10.11-16, and 12.4) is employed. Across that, questions representing students' social interactions (12.5-7, 12.9-13) and questions embodying their emotional experiences (12.1-3, 17.1-5) are used, and correlation analysis is conducted. For the first set of correlation analysis between design studio satisfaction, a shortened Pearson's Correlation test results table with correlation values higher than 0.4 ($\rho > 0.4$ ($p = 0.001$)) are shown on Table-2.

**Table 2 – Pearson's correlation values for online course satisfaction and social interactions (shortened table of Pearson's Correlation (ρ > 0.4, p = 0.001)**

| | | 12. 5. Online studio strengthens my sense of belonging for the instructors and faculty | 12. 6. Online studio classes strengthen my friendships | 12.7. I feel more confident in online communication with my friends | 12. 9. I miss my university's physical study environment | 12.10. I miss my university's face-to-face social environment |
|---|---|---|---|---|---|---|
| 10.2. I can concentrate online courses more | Pearson Corr. | .590** | .494** | .526** | -0,167 | -0,155 |
| | Sig. (2-tailed) | 0,000 | 0,000 | 0,000 | 0,053 | 0,074 |
| | N | 134 | 134 | 134 | 134 | 134 |
| 10.5. Online critics are more efficient | Pearson Corr. | .588** | .413** | .421** | -0,144 | -0,112 |
| | Sig. (2-tailed) | 0,000 | 0,000 | 0,000 | 0,097 | 0,198 |
| | N | 134 | 134 | 134 | 134 | 134 |
| 10.6. Making online presentation s are more effective | Pearson Corr. | .527** | .386** | .374** | -0,126 | -0,115 |
| | Sig. (2-tailed) | 0,000 | 0,000 | 0,000 | 0,146 | 0,188 |
| | N | 134 | 134 | 134 | 134 | 134 |
| 10.7. Online group-work practices are more efficient | Pearson Corr. | .563** | .458** | .542** | -0,108 | -0,145 |
| | Sig. (2-tailed) | 0,000 | 0,000 | 0,000 | 0,215 | 0,095 |
| | N | 134 | 134 | 134 | 134 | 134 |
| 10.8. I spend less time for accomplishing ODS | Pearson Corr. | .534** | .407** | .439** | -0,047 | -0,075 |
| | Sig. (2-tailed) | 0,000 | 0,000 | 0,000 | 0,593 | 0,388 |
| | N | 134 | 134 | 134 | 134 | 134 |
| 10.12. My design could have been better in a physical classroom | Pearson Corr. | 0,007 | 0,019 | -0,105 | .625** | .600** |
| | Sig. (2-tailed) | 0,935 | 0,825 | 0,229 | 0,000 | 0,000 |
| | N | 134 | 134 | 134 | 134 | 134 |
| 10.14. Evaluation of the ODS is better than the physical juries | Pearson Corr. | .611** | .427** | .421** | -0,055 | -0,067 |
| | Sig. (2-tailed) | 0,000 | 0,000 | 0,000 | 0,529 | 0,445 |
| | N | 134 | 134 | 134 | 134 | 134 |
| 10.16. My attendance increased | Pearson Corr. | .529** | .424** | .391** | 0,011 | 0,003 |
| | Sig. (2-tailed) | 0,000 | 0,000 | 0,000 | 0,899 | 0,971 |
| | N | 134 | 134 | 134 | 134 | 134 |
| 12.4. If possible, I would stay at home and go on with ODS | Pearson Corr. | .693** | .584** | .602** | -.277** | -.293** |
| | Sig. (2-tailed) | 0,000 | 0,000 | 0,000 | 0,001 | 0,001 |
| | N | 134 | 134 | 134 | 134 | 134 |

**. Correlation is significant at the 0.01 level (2-tailed)

Similar to the findings discussed for RQ1, students who are satisfied with the social aspects of the ODS setup think that their sense of belonging towards the instructors and faculty are improving, and they are more confident in ODS rather than face-to-face studio environment. These students are more eager to retain the ODS setting in the future, if that becomes possible, with one of the most significant ρ values ($r(133) = .693$, $p < .001$). On the other hand, the statement "I could have prepared much better projects in the physical studio environment" has significant correlation values across 'I miss my university's physical study environment' ($r(133) = .625$, $p < .001$) and 'I miss my university's face-to-face social environment' ($r(133) = .600$, $p < .001$). Student comments exposes this contrast between the students who are comfortable with the ODS setup and the others who miss the face-to-face studios and the social environment. However, the percentage of students who approve the statements 'I miss my university's physical study environment' (%52,6) and 'I miss my university's face-to-face social environment' (%51,4) have the majority compared to the students who think that their sense of belonging towards the instructors and faculty are improving (%26,3).

The second set of correlation test is done to explore the relationship between ODS satisfaction and students' emotional experiences. Results of this second test shows that there is a significant relation between student's feeling of tiredness and increased studio concentration ($r(132) = .554$, $p < .001$), lowered time consumption for accomplishing ODS ($r(134) = .541$, $p < .001$), and wishing to stay home and maintaining ODS ($r(133) = .517$, $p < .001$). Similar to the first test of correlation for social interactions, the approval of these evaluations are between 27,3% and 32,1%. This test underlines another and more powerful relation between the time saved from traffic and other activities. Students approval of feeling happy for the time saved from commuting to the university (%42,5) show a significant relationship with their ODS satisfaction. These students think that watching ODS recordings do help improve their work ($r(132) = .636$, $p < .001$), are expecting a higher GPA ($r(131) = .551$, $p < .001$), and want to retain the ODS setup, if possible ($r(132) = .520$, $p < .001$).

Problems about the loss of peer interaction and challenges due to their mixed emotional status are also significant in the student comments. They commented on loss of motivation (S85), the physical and psychological damage caused by their immobility in the at-home ODS setup (S31), loss of social and educational interaction with their peers (S65) as well as instructors (S118). These students asked for returning the face-to-face, conventional design studio setup. On the contrary, other students put forward advantages they perceived as studio session recordings, screening other student's projects, constant focus(S56), benefits of avoiding traffic (S63), and making good use of time (S99), for asking the ODS setup to continue in the future. These results endorse the suggestions of RQ2, so the null hypothesis is rejected. However, these opposite evaluations bring more questions to examine, especially about their relation with the demographic data.

**Evaluation of Research Question 3**

In order to test the RQ3, gender and YofS are selected as powerful demographics indicators. Gender data had three, and YofS had four independent groups. In order to determine whether these independent groups are same or different on some variables of interest such as the Likert scale evaluations for relevant questions, a non-parametric test of independent samples is needed.

As the nonparametric equivalent of one-way ANOVA, Kruskal-Wallis test is preferred since the test does not assume a normal distribution of the underlying data. Tests are conducted to check any possible relation between these student demographics with ODS satisfaction, and social and emotional status of the students during the pandemic affected semester. The same question sets used for RQ1 and RQ2 are employed for the variables that evaluate the students' perceptions about their ODS satisfaction (Q10.1-9, 10.11-16, and 12.4), with social (Q12.5-7, 12.9-13), and emotional (Q12.1-3, 17.1-5) status.

Kruskal-Wallis nonparametric test showed 2 significant differences for gender across students' evaluations on their social and emotional status. Significance values adjusted by Bonferroni correction for multiple tests display significant difference, $\chi 2(1, N = 133) = 4.552$, $p = .033$ for 'ODS strengthens my sense of belonging to the faculty', and $\chi 2(1, N = 119) = 4.636$, $p = .031$ for 'I have mixed feelings'. While male students were more positive about the online classes for strengthening their sense of belonging towards the faculty (Q12.5), female students have more 'mixed feelings' during the pandemic enforced online studio (Q 17.5). No significant difference is detected between the performance evaluations of male and female students, considering the technology-based structure of the ODS. No evidence that supports the findings of the research conducted by Demirbaş & Demirkan (2007) have been found.

For the social and emotional status evaluations, YofS showed statistically significant differences that are shown on Table-3. In pairwise comparisons for YofS across 'frequency of meeting classmates', first-year students show significantly lower frequencies than the fourth-year students. 'Online studio concentration', is significantly lower for first-year students compared to fourth-years. First and second-year students' 'time spent for online design work' is significantly higher than fourth-years. First-year students' agreement on the 'eagerness to retain online studio setting if possible', is significantly lower from the fourth-year students.

**Table 3 - Kruskal-Wallis nonparametric test results**

| | Mean | SD | YofS | N | Mean Rank | Result |
|---|---|---|---|---|---|---|
| 10.2. I can concentrate online courses more | 2,83 | 1,351 | 1 | 33 | 53,44 | H = 8.456, df=3, p = .037 |
| | | | 2 | 35 | 62,71 | |
| | | | 3 | 35 | 70,36 | |
| | | | 4 | 28 | 79,46 | |
| | | | Total | 131 | | |
| 10.8. I spend less time for accomplishing ODS | 2,90 | 1,397 | 1 | 33 | 57,64 | H = 9.275, df=3, p = .026 |
| | | | 2 | 35 | 57,93 | |
| | | | 3 | 35 | 68,63 | |
| | | | 4 | 28 | 82,66 | |
| | | | Total | 131 | | |

*Table 3 continued*

| | | | | | | |
|---|---|---|---|---|---|---|
| 12.4. If possible, I would stay at home and go on with ODS | 2,77 | 1,480 | 1 | 33 | 51,17 | H = 12.335, df=3, p = .006 |
| | | | 2 | 35 | 61,73 | |
| | | | 3 | 36 | 72,96 | |
| | | | 4 | 28 | 82,23 | |
| | | | Total | 132 | | |
| 12.13. I am meeting with my classmates face-to-face whenever it is possible | 2,92 | 1,363 | 1 | 33 | 51,67 | H= 12.647, df=3, p = .005 |
| | | | 2 | 34 | 59,22 | |
| | | | 3 | 36 | 73,04 | |
| | | | 4 | 28 | 82,07 | |
| | | | Total | 131 | | |

Depending on the findings of the RQ1 and RQ2, two more Kruskal-Wallis nonparametric tests are conducted for examining the relationship between YofS across 'sketching problems with mouse/trackpad' and 'missing the face-to-face study and social environment of the university' evaluations. Statistical results revealed that there is no significant relation between these evaluations and students' YofS. A fourth year student has problems making sketches using a mouse or trackpad, just as the first year students. Similarly, missing the face-to-face environment of the university is not related to being a junior or senior. With these results, the null hypothesis for RQ3 is rejected.

## DISCUSSION AND FURTHER RESEARCH

Evaluations show that the interaction between the students is not the way it is used to be during the face-to-face design studios. Students argue that the mutual assistance between them is lost and they feel lonely. Apart from its huge psychological impact, the loss of cooperation and loosened communication between the students are contradictory and detrimental to the very nature of the design studio education. Moreover, student–instructor interaction is also interrupted. Analysis show that student's sense of belonging increases as long as the ODS adoption is achieved. Fourth-year students signal a higher level of satisfaction from the ODS and show more eagerness to retain ODS setting. On the other side, first-year students, who are having challenges for obtaining the fundamentals of design knowledge are highly unsatisfied. They are also feeling the absence of instructor and peer interaction, and longing for social aspects of campus life.

Results also show signs of psychological and physiological problems. More than half of the students reveal that they miss the university campus. More than one third of the students admit they do not feel themselves good at all and have nervous breakdowns from time to time. Although discussing these topics is out of the scope of this research, these issues have obvious effects on the ODS adoption and student performance. Therefore, they should be addressed by further research for future ODS settings.

Under the light of the main findings of this research, further research directions for a future ODS planning are identified as follows:

- Regarding the fundamental educational techniques of the conventional design studio, ODS eventually brings its technical equipment requirements. More research is needed to track down the necessary tools and equipment for a successful ODS setup, such as the ones for sketching. How institutions can provide these for students and the relevant training they need for using these tools with a compatible curriculum should also be considered.

- It appears that students have different social needs and distinctive psychological mindsets especially depending on their YofS. Further research should consider this extensive challenge to avoid this 'social divide' between students and take measures to enable both student–instructor and student–student interactions. Social and emotional counseling services can also be examined to be integrated to the educational program.

- Features such as digital presentations, recorded critics and juries, have remarkable benefits for students and enable a more concentrated and egalitarian setting for educational purposes. The existing technological equipment seems ready for switching into hybrid educational models, as more research is needed to develop a mixed educational content and open up new horizons for digitalizing the design studio.

- More extensive research on the experiences of the faculty during the emergency ODS setup will also be prospective for the further development of the ODS.

The objective of this research is to tackle with the educational drawbacks of the ODS education during the challenging period of Covid-19 restrictions and provide implications for the digitalization of design studio education. However, shortcomings and effects of this irregular design studio setup on the students' future professional practice also demands a wider research worth considering.

## CONCLUSION

The unexpected and extensive emergency between 2020-2022 created a useful test environment that incorporates valuable data for the digitalization of architectural education. Using the data obtained from architecture and interior architecture students, this research underlines the challenges of the emergency ODS classes, and exposes digital sketching and YofS as a breaking point between the students. ODS is endorsed for being more egalitarian by its ease on reaching resources, watching recorded lectures and critics, presenting their work digitally both for critics and juries. While student's interest is focused on these topics, the drawbacks of the ODS includes lack of peer learning, and limited one-on-one student-instructor interaction. Technical resources of the students are detected to be effective over their ODS satisfaction. The challenge for digital sketching using a mouse or trackpad is the most prominent technical difficulty that directly effects ODS satisfaction. First-year students' strong reaction towards ODS emphasizes different knowledge levels and educational needs of students depending their YofS. These findings support the importance of the discussion made by Akçay Kavakoğlu et al., (2021). Institutions should be

requiring more specialized components that can assist students and instructors to transform their sketches and drawings into a digital environment. Otherwise sketching as a fundamental part of the design studio should be addressed outside the studio, which will inevitably be the subject of a fierce discussions.

This research is limited with its sample size and the researched universities. A wider research with convenient sample size and students from different universities from diverse regions or countries may explore more diverse parameters. Effects of the students' study environment during this ODS period and the readiness of the instructors are other important topics that should be examined in further studies. Further research is imminent to comprehend the required tools, equipment and methods for a future ODS setup. Recommendations of this study are expected to be valuable for the future research on developing this agenda.

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## Author Contribution Statement

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| D. Danışmanlık / Supervision | E. Malzeme, Kaynak Sağlama / Material, Resource Supply | F. Veri Toplama, İşleme / Data Collection, Processing |
| G. Analiz, Yorum / Analyses, Interpretation | H. Metin Yazma / Writing Text | I. Eleştirel İnceleme / Critical Review |

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