



# Medical Education During the COVID-19 Pandemic: Habits, Computer Skills, Internet Use Disorder, and Success

*COVID-19 Pandemisi Sırasında Tıp Eğitimi: Alışkanlıklar, Bilgisayar Becerileri, İnternet Bağımlılığı ve Başarı*

Elif Kervancıoğlu Demirci<sup>1</sup>, Gulnaz Kervancıoğlu<sup>2</sup>, Salih Cayır<sup>3</sup>, Eren Kervancıoğlu<sup>3</sup>, Ertan Sarıdoğan<sup>4</sup>

<sup>1</sup>Department of Histology and Embryology, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Türkiye; <sup>2</sup>Department of Histology and Embryology, Faculty of Medicine, Istanbul Aydın University, Istanbul, Türkiye; <sup>3</sup>Istanbul Faculty of Medicine, Istanbul University, Istanbul, Türkiye; <sup>4</sup>Department of Gynaecology, University College London Hospital, London NW1 2BU, UK

## ABSTRACT

**Aim:** COVID-19 pandemic had a significant impact on the way medical education is delivered. In most countries education was provided remotely. In this study, we aimed to study whether social and online habits, computer readiness, online communication skills, and Internet Use Disorder (IUD) were significant characteristics affecting the preferences of medical students for online or traditional classroom teaching in histology and embryology.

**Material and Method:** In 2019-2020, the fall semester for Turkish universities was face-to-face. Due to the COVID-19 pandemic, the spring semester of that academic year was online. We asked 1,144 public and private university students in Istanbul about demographic characteristics and their preferences in learning and general living, using two subscales of the Online Learning Readiness Scale (OLRS) and the Young Internet Addiction Scale. We compared online and face-to-face success levels using quiz results.

**Results:** Students generally preferred traditional lectures. However, those with higher OLRS scores preferred online lectures and learning materials and were more adapted to online living. Internet use disorder did not correlate with online lecture preferences. The results from private and public universities were not considerably different. The success levels after online lectures were better than after face-to-face lectures, which suggests that the preferences and satisfaction of students are different from their learning achievement.

**Conclusion:** Preferences of students should be the priority in planning medical education. They want online lectures available as complementary to face-to-face lectures. Therefore, instructors should improve their online communication and teaching skills to enhance students' online lecture satisfaction. The IUD does not possess a risk in this condition. Contrarily, regularly planned complementary online courses will enhance students online learning habits, online readiness and achievement and enables a more effective continuation of education in cases of natural disasters and pandemics.

**Key words:** distance education; histology; internet addiction disorder; online education

## ÖZET

**Amaç:** COVID-19 pandemisinin tıp eğitimi üzerinde önemli bir etkisi oldu. Çoğu ülkede eğitim uzaktan yapıldı. Bu çalışmada, tıp öğrencilerinin sosyal ve çevrimiçi alışkanlıklarının, bilgisayar okur yazarlıklarının, çevrimiçi iletişim becerilerinin ve İnternet Kullanım Bozukluğunun histoloji ve embriyolojideki çevrimiçi veya geleneksel sınıf öğretimi tercihlerini etkileyen önemli özellikler olup olmadıklarını araştırmayı amaçladık.

**Materyal ve Metot:** 2019-2020'de Türkiye'de üniversiteler için güz dönemi yüz yüze idi. Aynı akademik yılın bahar dönemi COVID-19 salgını nedeniyle çevrimiçi yapıldı. İstanbul'daki 1144 devlet ve özel üniversite öğrencisine, demografik özelliklerini, öğrenme ve genel yaşamdaki tercihlerini, Çevrimiçi Öğrenmeye Hazırlık Ölçeği'nin (OLRS) iki alt ölçeğinin yanı sıra Genç İnternet Bağımlılığı Ölçeği'ni kullanarak sorduk. Sınav sonuçlarını kullanarak çevrimiçi ve yüz yüze başarı düzeylerini karşılaştırdık.

**Bulgular:** Öğrenciler genellikle geleneksel dersleri tercih ettiler. Ancak, OLRS puanları daha yüksek olanlar çevrimiçi dersleri ve öğrenme materyallerini tercih ettiler ve çevrimiçi yaşama daha fazla adapteydiler. İnternet Kullanım Bozukluğu ile çevrimiçi ders tercihi arasında korelasyon yoktu. Özel ve devlet üniversitelerinden elde edilen sonuçlar ise önemli ölçüde farklı değildi. Çevrimiçi derslerden sonraki başarı seviyeleri, yüz yüze derslere göre daha iyiydi; bu da öğrencilerin tercihlerinin ve memnuniyetinin öğrenme başarılarından farklı olduğunu gösterdi.

**Sonuç:** Tıp eğitiminin planlanmasında öğrencilerin tercihleri ön planda tutulmalıdır. Öğrenciler, çevrimiçi dersleri yüz yüze derslerin tamamlayıcısı olarak istemektedirler. Bu nedenle eğitmenler, öğrencilerin çevrimiçi ders memnuniyetini artırmak için çevrimiçi iletişim ve öğretim becerilerini geliştirmelidirler. Bu durumda, internet kullanım bozukluğu bir risk oluşturmamaktadır. Aksine düzenli planlanan tamamlayıcı çevrimiçi dersler öğrencilerin çevrimiçi öğrenme alışkanlıklarını, çevrimiçi okuryazarlıklarını ve başarılarını artıracak ve eğitimin doğal afet ve pandemi durumlarında daha etkin devamını sağlayacaktır.

**Anahtar kelimeler:** uzaktan eğitim; histoloji; internet bağımlılığı; çevrimici eğitim

**İletişim/Contact:** Elif Kervancıoğlu Demirci, Istanbul University, Faculty of Medicine, Department of Histology and Embryology, Millet Cad. İstanbul Tıp Fakültesi, Fatih-İstanbul, 34093, Türkiye • **Tel:** 0212 414 20 00 • **E-mail:** elifkervancioglundemirci@istanbul.edu.tr • **Geliş/Received:** 23.07.2022 • **Kabul/Accepted:** 14.04.2023

**ORCID:** Elif Kervancıoğlu Demirci, 0000-0002-3158-9300 • Gulnaz Kervancıoğlu, 0000-0002-4737-3053 • Salih Cayır, 0000-0002-4071-5188 • Eren Kervancıoğlu, 0000-0001-7845-9995 • Ertan Sarıdoğan, 0000-0001-9736-4107

## Introduction

Technology in education progressed rapidly in the last century<sup>1</sup>. Different nations led radical reforms by adapting information and communication technologies to their educational systems<sup>2</sup>. Those educational strategies were determined after considering student attitudes to technology and their computer skills amongst other specifications such as satisfaction<sup>3</sup>.

Histology is the microscopic study of tissues and cells and is considered as microscopical anatomy. Embryology is the study of embryo and concerned with the formation and development of that. Both require theoretical knowledge and three-dimensional imagination, and they are compulsory courses in medical education. Therefore, histology and embryology lectures include practical sessions with microscopic specimen observation and drawing by students<sup>4</sup>. Theory sessions are supported with additional learning materials, such as microscopy images, videos and plastic models. On the other hand, virtual microscopy is becoming popular for histology and especially for pathology, but it has not replaced traditional microscopes in medical education worldwide<sup>5-7</sup>.

The histology and embryology lectures are mainly face-to-face in medical education. However, medical education has been offered online in many countries during the COVID-19 pandemic<sup>8</sup>. Instructors and students had to switch to online courses in histology and embryology. Detailed evaluation of these experiences is likely to assist in optimizing online education. Therefore, it is essential to define practical online education-related factors and student preferences.

The medium of online education is the Internet, which is becoming a part of daily life for millions, simplifying processes from education to finance<sup>9</sup>. Despite its advantages, its psychological impacts may include depression, lowered mood, and behavioral addiction<sup>10</sup>. Internet Use Disorder (IUD) is described in the third section of the Diagnostic and Statistical Manual of Mental Disorders, fifth edition, as an online gaming disorder (American Psychiatric Association 2013), and the International Classification of Diseases, 11th revision, includes the code "Gaming Disorder, predominantly online; 6C51," but debate continues about the existence of IUD<sup>11-13</sup>. Therefore, IUD is usually used not as a diagnosis but a tendency toward a high Young Internet Addiction Scale (YIAS) score<sup>14</sup>. The digital

literacy is a need for academic purposes, but the effect of digital literacy on IUD is an ongoing debate<sup>15,16</sup>.

In Türkiye, internet use is becoming widespread, especially among young people, and Internet related disorders are increasing<sup>17</sup>. Therefore, we investigated the prevalence of IUD and how it affects medical course preferences.

According to published research, levels of satisfaction with online education are affected by socio-demographics, instructor-student interaction, Internet self-efficacy, and other variables<sup>18,19</sup>. Our study aimed to investigate student habits, computer and Internet self-efficacy, online communication self-efficacy, and the effects of IUD on online course preferences, while comparing a public medical school with a private medical school. We examined these factors for theoretical and laboratory courses in histology and embryology with the hope that our findings may provide insight to adapt technologies for future medical education.

## Methods

The study was conducted at the medical schools of two universities in the same Turkish province: Istanbul University (IU) and Istanbul Aydin University (IAU). A total of 1,144 volunteer undergraduate university students, who had histology and embryology courses in their first or second years, participated in the study. In the IAU group, 131 students were studying dentistry but taking medical school histology and embryology classes with the same curriculum and education staff. Students gave their informed consent to participate. The online survey was completed in a single attempt, through Microsoft Forms. The study was approved by the Clinical Research and the Social Research Committees of Istanbul University (08.06.2020-Number: 91654).

## Questionnaires

The survey consisted of four parts: demographic characteristics, questions for evaluating different methods used in histology and embryology education, the computer and Internet self-efficacy subscale and online communication self-efficacy subscale of the Online Learning Readiness Scale (OLRS), and the Young Internet Addiction Scale (YIAS).

### *Sociodemographics*

Sociodemographic characteristics included were gender (male or female), age, economic status, owning a personal computer, having a consistent Internet connection, accommodation during education, having a private study area during the pandemic, and having a private study area before the pandemic.

### *General Habits*

Questions about regular life habits were concerned with online options, including “Have you ever had an online course before?”, “Which way do you do your general shopping (online shopping or conventional shopping from store)?”, “Which of the following would you choose when you want to learn a new skill (online course or traditional schooling/private course)?”, and “What is your preferred way of socializing (digital platforms such as social media or face-to-face communication)?”

### *Online Learning Readiness Scale*

The OLRS is a self-reported questionnaire consisting of 18 items. It includes five subscales: a) self-directed learning, b) motivation for learning, c) computer and Internet self-efficacy, d) learner control, and e) online communication self-efficacy<sup>20</sup>. This study used the validated Turkish version of the computer and Internet self-efficacy subscale and online communication self-efficacy subscale of the OLRS<sup>21</sup>. The Cronbach’s alpha value of this version is 0.95.

### *Histology and Embryology Education*

Students took theoretical and practical sessions of histology and embryology in the fall semester 2019 and spring semester 2020. Traditional classroom sessions were held in the fall semester and online sessions in the spring semester. This was similar at both universities because of the COVID-19 pandemic (Table 1).

The medical curricula were similar in line with the government’s educational standards. Traditional theoretical sessions were face-to-face in a lecture hall or classroom. Traditional practical sessions were face-to-face in the basic sciences laboratory of the Histology and Embryology Department, where each student could study slides through their microscope. The slides were fixed cytological smears or 4- $\mu$ m tissue sections, stained with various dyes such as hematoxylin and eosin for general nucleus cytoplasm differentiation, Masson’s

**Table 1**

| Semester – Fall 2019   | Semester – Spring 2020   |
|--|--|
| Before lockdown  | During Lockdown  |
| Traditional face-to- face education for theoretical and practical lectures | Online theoretical and practical lectures, available also offline for rewatching |

trichrome stain for connective tissue, silver stains for nervous tissue, or other special stains such as Diff-Quik or Papanicolaou for sperm. The same slides were used for traditional and online lectures. Online theory sessions used Adobe Connect software for distance learning adapted for medical education. The lecturer and their presentation could be seen and heard at the same time, with pointing on the presentation or whiteboard drawing, and screen share options. Their presentations included atlas drawings, slide images and videos, which they prepared with a microscope before the lecture. They gave online lectures with these materials and interactively discussed slides with students. Both online theory and practical sessions had a live chatbox and microphone option for each student to provide an interactive lecturer-student dialog. The computer programs and histology and embryology teaching methods of both universities were the same.

Because of the complex theoretical and visual content of histology and embryology, we developed questions about these different course methods to compare the perceptions and choices of students about lectures. Furthermore, we added a question for the after-pandemic courses: “Do you want to be able to watch face-to-face classes online as a part of formal education?”

### *Young Internet Addiction Scale*

The YIAS consists of eight items, and respondents who answered “yes” to at least five were classified as an Internet-dependent<sup>14</sup>. The Turkish version, with a Cronbach’s alpha value of 0.716, was used for this study<sup>17</sup>.

### *Quiz*

The IU students took an online quiz of 10 questions about what they learned in the online practical sessions in 2020. These results were compared with the previous year’s traditional laboratory quiz results on the same histology and embryology topics.

### Statistical analysis

Statistical Package for Social Sciences (SPSS) program version 22 software was used for all statistical analyses. Group differences involving demographic variables were computed by using chi-square and independent t-tests. The comparison of OLRs scores between the IUD group and the control group was assessed using the independent t-test. Binary logistic regression analysis was used to evaluate the relation of online learning readiness to demographic characteristics, regular life habits concerning online options, and histology and embryology education preferences. Statistical significance was defined as  $P < 0.05$ . The normality of distribution of the data was evaluated by the skewness and kurtosis values.

## Results

### Demographics

Of 1,144 participants, 70 returned missing or incomplete data. The final online survey questionnaire results comprised 1,074 medical students (541 male, 50.4%; 533 female, 49.6%) from public (838, 78%) and private (236, 22%) medical schools. Of the respondents, 179 (16.7%) reported that they had taken an online course before. This was higher in private university students than public university students (36% vs 11.2%,  $\chi^2=81.54$ ,  $P < 0.001$ ). A statistically significantly different number of students between the private and public university groups preferred online education for overall university education (Table 2). Preference for overall online university education was significantly different; of the public university group, 42.2% reported that they preferred online courses, compared to 20.8% in the private university group ( $\chi^2=39.23$ ,  $P < 0.001$ ) (Table 2).

Of the total sample, 465 students (43.3%) reported social media as their principal reason for Internet use, while 183 (17%), 339 (31.6%), and 87 (8.1%) students primarily used it for education and research, visual content and gaming, respectively. The differences between the public and private university groups were not statistically significant.

Most students (879, 81.8%) reported the city center as their regular place of accommodation before university, while 38 (3.5%) and 157 (14.6%) came from rural areas and suburbs, respectively.

**Table 2.** Public and private university participants' socio-demographic data, OLRs scores, histology and embryology education preferences, and regular life habits concerning online and face-to-face options.

|   | Total (1074) |
|---|--------------|
| Economically independence                           | 880 (82.3%)  |
| Having a private place to study                     | 820 (76.4%)  |
| Having a personal computer                          | 926 (86.2%)  |
| Having a constant internet connection               | 884 (82.3%)  |
| Online course experience in the past                | 179 (16.7%)  |
| Blended course preference after pandemic            | 862 (80.3%)  |
| Higher Young Internet Addiction Score               | 379 (35.3%)  |
| Online learning readiness score (OLRS)              |              |
| Computer/internet self-efficacy                     | 10.8±2.8     |
| Online communication self-efficacy                  | 10.5±2.6     |
| Histology and embryology online theory education    |              |
| Asking questions                                    | 277 (41.6%)  |
| Learning better                                     | 244 (30.1%)  |
| Prefer  | 257 (27.8%)  |
| Histology and embryology online practical education |              |
| Asking questions                                    | 123 (13%)    |
| Learning better                                     | 96 (9%)      |
| Prefer  | 103 (10.2%)  |
| Online shopping preference                          | 385 (35.8%)  |
| Online course preference for learning a new skill   | 278 (25.9%)  |
| Preferences for online histology materials          | 280 (26.1%)  |
| Distance problem between campus and accommodation   | 335 (31.2%)  |

### Education Preferences of Students At Private and Public Universities

Table 2 compares self reported histology and embryology theoretical and practical education preferences of the students. Among all students, 41.6% asked questions with more confidence, and 30.1% learned better in online theory education. These numbers were higher for the public university than the private university (46.2% vs 26.9%,  $\chi^2=18.7$ ,  $P < 0.001$ ; 32.2% and 23.2%,  $\chi^2=5.6$ ,  $P=0.017$ ). Public university students were more likely to prefer online theoretical education (30.3% vs 19.3%,  $\chi^2=9.5$ ,  $P=0.02$ ).

Practical education preferences for histology and embryology differed significantly between the public and private university groups. Online, classroom, and laboratory practical sessions were preferred by 10.4%, 3.4%, and 86.2% of public university students, respectively, compared to 9.8%, 16.8%, and 73.4% of private university students ( $\chi^2=51.7$ ,  $P < 0.001$ ).

### Relationship Between Education Preferences, Life Habits, and Demographics

Gender, having a personal computer, having past experience of an online course, IUD, purpose of Internet

**Table 3.** Histology and embryology education preference differences by socio-demographic data and regular life habits concerning online options.

|   | Online (257/27.8%) | Traditional (667/72.2%) |
|---|--------------------|-------------------------|
| Economically independent *  | 222 (86.4%)        | 533 (80.3%)             |
| Having a private place to study **                                  | 212 (82.5%)        | 490 (73.5%)             |
| Having a constant internet connection ***                           | 231 (89.9%)        | 526 (78.9%)             |
| Prefer online courses ***   | 190 (73.9%)        | 144 (21.6%)             |
| Higher Young Internet Addiction Score                               | 98 (38.4%)         | 228 (34.8%)             |
| Internet shopping preference **                                     | 107 (41.6%)        | 217 (32.5%)             |
| Online course preference for learning a new skill ***               | 99 (38.5%)         | 131 (19.6%)             |
| Digital platform preference for socializing ***                     | 65 (25.3%)         | 79 (11.8%)              |
| Online learning material preference for histology and embryology ** | 79 (30.7%)         | 150 (22.5%)             |
| Have distance problem between school and home **                    | 101 (39.3%)        | 188 (28.2%)             |

Chi-square test \* p&lt;0.05; \*\* p&lt;0.01; \*\*\* p&lt;0.001

**Table 4.** Online learning readiness level by demographic characteristics, histology and embryology education preferences, and regular life habits concerning online options.

|   | Computer/internet self-efficacy scores (mean) | Online communication self-efficacy scores (mean) |
|---|---|--|
| Prefer online courses (yes/no)                  | 11.4±2.7/10.4±2.7***                          | 10.9±2.6/10.3±2.6***                             |
| Young Internet Addiction Score (high/low)       | 10.7±2.9/10.8±2.7                             | 10.3±2.6/10.7±2.6*                               |
| Histology and embryology theory education       |   |  |
| Asking questions                                |   |  |
| online lessons/class lessons                    | 11.3±2.6/10.2±2.9***                          | 11±2.5/10.3±2.8***                               |
| Learning better                                 |   |  |
| online lessons/class lessons                    | 11.1±2.9/10.4±2.8***                          | 10.7±2.5/10.2±2.7*                               |
| Prefer  |   |  |
| online lessons/class lessons                    | 11.4±2.8/10.5±2.7***                          | 10.9±2.7/10.4±2.6*                               |
| Histology and embryology practical education    |   |  |
| Asking questions                                |   |  |
| online lessons/class lessons/lab lessons        | 11.2±3/9.7±2.9/10.8±2.7***                    | 11.5±2.6/10±2.6/10.3±2.6***                      |
| Learning better                                 |   |  |
| online lessons/class lessons/lab lessons        | 11.6±3/9.2±2.9/10.7±2.7***                    | 11.2±2.5/9.3±3/10.5±2.6***                       |
| Prefer  |   |  |
| online lessons/class lessons/lab lessons        | 11.6±3/9.4±2.7/10.9±2.7***                    | 11.4±2.5/9.8±2.5/10.4±2.6***                     |
| Preference for histology learning materials     |   |  |
| online/printed                                  | 11±2.6/10.4±2.9***                            | 10.7±2.5/10.3±2.7**                              |
| Shopping preferences (online/traditional store) | 11±2.8/10.6±2.7**                             | 10.8±2.7/10.3±2.6*                               |
| Preference for learning a new skill             |   |  |
| online courses/traditional courses              | 11.3±3/10.6±2.7***                            | 11.1±2.7/10.3±2.6***                             |
| Preferences for socializing                     |   |  |
| Digital platforms /face-to-face communication   | 11.1±2.6/10.7±2.8                             | 10.7±2.7/10.5±2.6                                |
| Economically (independence /dependence)         | 11±2.6/9.4±2.9***                             | 10.6±2.6/10.03±2.9**                             |
| Having a computer (yes/no)                      | 11.0±2.7/9.4±2.8***                           | 10.5±2.4/9.9±2.7**                               |
| Constant internet connection (yes/no)           | 11.1±2.6/9.2±3.0***                           | 10.7±2.5/9.6±2.8***                              |

Independent t-test \* p&lt;0.05; \*\* p&lt;0.01; \*\*\* p&lt;0.001

use, and accommodation did not differ between students who preferred online or face-to-face lectures. However, economic independence, having a private place to study, having a constant Internet connection, online course preference, digital or face-to-face communication for socializing, digital or hardcopy preference for studying histology and embryology, and distance between campus and accommodation differed between these two groups (Table 3).

### Relationship Between Education Preferences and Online Learning Readiness

The mean scores for the computer and Internet self-efficacy and online communication self-efficacy OLRs subscales were significantly higher in students who asked questions with more confidence and learned better during online histology and embryology education. Students who were more likely to prefer online theory

**Table 5.** Binary logistic regression analyses of online learning readiness for histology and embryology education preferences, comparing online education and traditional education choices.

| Category                           | Beta | SE   | OR   | p-value |
|------------------------------------|------|------|------|---------|
| Computer/internet self-efficacy    | 0.08 | 0.03 | 0.92 | p=0.007 |
| Online communication self efficacy | 0.03 | 0.03 | 0.97 | p=0.29  |

SE: standard error; OR: odds ratio; adjusting for the covariate variables: university (public/private), regular life habits concerning online options, and constant internet connection.

education showed higher mean scores for each OLRS category (Table 4).

Table 5 shows the results of the logistic regression model used to compare online learning readiness levels and histology and embryology education preferences. University (public or private), regular life habits concerning online options, and having a constant Internet connection were analyzed in the model. Higher computer and Internet self-efficacy scores significantly predicted histology and embryology education preferences, whereas online communication self-efficacy scores were not a significant predictor for education preferences.

#### *IUD Prevalence in Medical Students*

Of the total sample, 35.3% of students were assessed as Internet-dependent according to the YIAS. Internet use disorder was significantly more prevalent in the public university group compared with the private university group (37.5% vs 30.1%,  $\chi^2=4.4$ ,  $P=0.036$ ; Table 2). No significant differences between genders were found in the IUD group compared to the control group. No significant differences existed in choice of education method among the IUD group and control group. As shown in Table 4, the mean online communication self-efficacy score was significantly higher in the control group compared to the IUD group.

#### *Quiz Results*

The practice quiz was taken by 888 students in 2020 and 824 students in 2019. The success level of students in the online quiz was higher than the face-to-face quiz (88.06% vs 83.46%,  $P < 0.001$ ).

## **Discussion**

In this study, we aimed to evaluate a variety of factors that may affect medical students' histology and embryology learning preferences.

The IU students described themselves as more economically independent, and they were more likely to have a private study space and a constant Internet connection

than the IAU students (Table 2). This may be due to the large number of international students and students with full scholarships at IAU. The percentage of students with previous online course experience was higher at IAU. The preference for online learning for new skills was also higher at this private school. This suggests that previous exposure to online courses influences preferences for educational set-up. It is likely that developing online learning habits takes time and longer exposure may change preferences further. The online histology and embryology courses were the first online lecture experience for some students. In our study, the participants experienced traditional and online classes in the same academic year, potentially facilitating them to make a direct comparison.

In addition to cost and time efficiency, online courses have several other benefits, such as availability of offline documents and easy program management and monitoring. Moreover, students reportedly find blended courses more satisfactory than wholly online or classroom lectures<sup>22</sup>. A higher percentage of our students preferred regular classroom sessions over online classes, but most wanted blended courses after the pandemic (Table 2).

Many students had personal computers or tablets, and the rest used university library computers or shared the family computer (Table 2). Some students with limited resources tended to choose a smartphone over a personal computer. The evolved technology of smartphones enables most activities necessary for studying. Therefore, online courses or learning materials should not just be planned for personal computers but also be available through mobiles for the future. All of the online theory courses in this study were available through smartphones. However, the larger screens of computers provide a better opportunity for learning the basic or specialized tissue structures of histology and embryology accompanied by the instructions from the education staff. Students are more engaged and motivated when they interact with the instructor<sup>19,23</sup>.

Medical students should adapt to technologies such as digital imaging and virtual microscopy since the United

States Food and Drug Administration has approved virtual microscope images to be used for diagnostic purposes<sup>24</sup>. This improvement will be applied even in other fields of medicine<sup>25</sup>. Therefore, medical students should have basic computer skills and be digital literate to enhance their vocational performance<sup>26,27</sup>. Each day, higher levels of technological skills are required. Without the necessary skills, students may develop a false perception of difficulty in learning higher computational skills, requiring much more effort from instructors<sup>28</sup>.

We used two subscales of the OLRs to test readiness for online learning. Economic factors such as independence and indirectly related parameters such as having a personal computer and constant Internet connection correlated with computer and Internet self-efficacy scores and online communication self-efficacy scores. Computer and Internet self-efficacy and online communication self-efficacy are necessary for better online learning performance and can change students' perception of online or traditional lessons. The students with higher scores generally preferred online courses to learn new skills. Medical students with higher computer and online communication self-efficacy scores preferred online lessons for histology and embryology theoretical and practical sessions. They asked their questions online with more confidence, and they learned online better. We assume the low computer and Internet readiness of the general population of students made them choose campus sessions over online sessions. The full daily program of online medical lessons and uncertainty of the future because of COVID-19 could have influenced their apprehension. The online courses were not optional, they were obligatory in spring 2020 because of the lock-down and governmental politics in COVID-19 pandemics.

The IAU students reported campus longing more often because of missing the social activities of the private university in their lives. The preference for practical sessions in the classroom – a virtual session without microscopes – was higher at IAU than IU. The smaller number of students in each class at IAU is a probable explanation for this. Another possibility is that the curfew, and pandemic-related distress and worry could have meant that students equated everything about campus with life before COVID-19. Anxiety and anhedonia increased during COVID-19<sup>27</sup>.

Similar characteristics were possible for educators. Their new work became conducting full-time e-teaching, converting theoretical lessons and designing

practical learning material online, and finding solutions for ongoing projects or pandemic-related pauses of projects. E-teaching became necessary for the instructors as an educational and practical technique and informatics skill. However, this revolution required more comprehensive changes, developments and time in normal conditions<sup>28</sup>. Online lectures were implemented worldwide as quick solutions in spring 2020. Further improvements of technology will probably be incorporated in the future based on student feedback, which can be more easily collected with online education<sup>22</sup>. Effectively collected feedback reported that a slight reduction in teaching hours had little impact on medical student learning outcomes and satisfaction<sup>29</sup>.

We assumed that regular habits could have an impact on the perception of histology and embryology learning online or face-to-face. The students who preferred online education were more likely to choose digital platforms for socializing instead of face-to-face communication. They also indicated choosing online instead of traditional courses to learn new skills. Students who choose to do their shopping online were more likely to prefer online histology and embryology education (Table 3).

Considering adaptation to online life, the reading habits for some have changed from hardcopy to online with time<sup>30</sup>. The behaviors, principles, and choices of people born after 1994, known as Generation Z, differ from those of older generations and tend to be more online<sup>31</sup>. Young people use the Internet for emailing, information searching, social networking and news reading at least once a day<sup>32</sup>.

Histology and embryology educational preferences were not associated with gender. Gender did not affect computer and Internet self-efficacy scores or online communication self-efficacy scores, either. However, economic independence, having a computer and constant Internet connection, online course experience in the past, and preference for online courses in the future did vary by gender.

Students with better Internet skills asked questions with more confidence, learned better in online theory and practical sessions, and preferred these sessions and online histology learning materials. Online skills were concordant with online course preference when learning new skills. The digital literacy is important for academic competence. Some studies suggested that higher digital literacy could be linked to increase in IUD amongst adolescents and did not affect the educational

performance<sup>33,34</sup>. The difference could be because of the selected age group and the context of education of the subjects in this study. Another study reported that IUD is an increasing danger for medical students and the lower YIAS scores were associated with higher information literacy<sup>35</sup>.

Internet addiction scale scores represent a possible negative for these students. Computer and Internet self-efficacy scores were not associated with IUD. However, the students with lower online communication self-efficacy scores had higher YIAS scores. We suggest that self-perception of low online communication skills may be due to social insecurity, shyness or low self-esteem, which can be considered factors for IUD<sup>36,37</sup>. A psychometric self report instrument was used in this study because of a lack of an standardized test for IUD. Therefore, the cut off scores gave only a hint towards the IUD tendency.

The students had better quiz scores after online courses than after traditional courses in our study. This result matches with recent studies<sup>38</sup>. However, some past studies have found that online learning outcomes did not differ from traditional education outcomes<sup>39,40</sup>. The reasons for this change are the evolution of software, increased experience of instructors and faster Internet. Student satisfaction is profoundly affected by their interaction with the instructor<sup>41</sup>. If the online learning environment enables functional communication, many students ask questions or discuss online more easily<sup>42</sup>. The most critical factor is the perceived technical, peer and instructional support<sup>43</sup>.

The success levels after the online histology and embryology courses were better than after the traditional courses. Nevertheless, students overall preferred face-to-face courses over online courses. However, students with higher online readiness scores preferred online courses. The inevitable truth is that the computer and online skills of the next generation will increase. On the other hand, we found that computer and Internet readiness did not correlate with IUD. Literature supports that students want digital histology learning materials as complementary to laboratory lectures with microscopes<sup>44</sup>. The students in our study were willing to continue with traditional courses, but they also wanted access to these lectures online or offline. Therefore, we should adapt histology and embryology courses online together with face-to-face lectures according to students' requests and the increasing computer use of young people.

## Conclusion

In this study, we showed first time in the literature that IUD is not associated with online course preferences, and it is not a danger for young people with high computer/internet readiness and high online communication skills. Behavioral patterns, such as internet habits, yield students learning material preferences, therefore they are useful for planning a complete online or an online assisted medical education. The instructors should improve themselves for better online teaching and communicating skills to ameliorate all students' online lecture perception, because the success levels of medical students are higher after online lectures. On the other hand, the technical support by the university as large screens for each student and satisfactory interactive online lectures in the program should be planned. This improvement and repetitive online sessions would enhance students' online lecture satisfaction, online learning habit, and achievement.

Histology and embryology have highly visual content and are basic scientific fields. This study was designed in this context. Further detailed studies should be planned and conducted for other preclinical and clinical areas of medical education according to the requirements of each specific discipline.

### List of Abbreviations

Internet Use Disorder: IUD

Young Internet Addiction Scale: YIAS

Online Learning Readiness Scale: OLRs

Istanbul University: IU

Istanbul Aydin University: IAU

### Conflict of Interest

The authors declare that they have no known competing financial interests that have effect the research in this paper.

### Ethical Approval

The study was approved by the clinical research committee and the social research committee of IU.

### Informed Consent

Students gave their informed consent to participate. All methods were performed in accordance with the relevant guidelines and regulations.



## References

1. Henderson M, Selwyn N, Aston R. What works and why? Student perceptions of 'useful' digital technology in university teaching and learning. *Stud High Educ.* 2017;42(8):1567–79.
2. Anderson J, Van Weert T, Duchâteau C. Information and communication technology in education: A curriculum for schools and programme of teacher development. 2002.
3. Kuo Y-C, Walker AE, Belland BR, Schroder KE. A predictive study of student satisfaction in online education programs. *International Review of Research in Open and Distributed Learning.* 2013;14(1):16–39.
4. Rafi A, Rauf A, Anwar MI. Significance of actually drawing microscopic images and its impact on students' understanding of histology. *Journal of the Dow University of Health Sciences (JDUHS).* 2017;11(3):77–81.
5. Hamilton PW, Wang Y, McCullough SJ. Virtual microscopy and digital pathology in training and education. *APMIS.* 2012;120(4):305–15.
6. Thompson AR, Lowrie DJ, Jr. An evaluation of outcomes following the replacement of traditional histology laboratories with self-study modules. *Anat Sci Educ.* 2017;10(3):276–85.
7. Chimmalgi M. Off-line virtual microscopy in teaching histology to the undergraduate medical students: do the benefits correlate with the learning style preferences? *Journal of the Anatomical Society of India.* 2018;67(2):186–92.
8. Ashokka B, Ong SY, Tay KH, Loh NHW, Gee CF, Samarasekera DD. Coordinated responses of academic medical centres to pandemics: Sustaining medical education during COVID-19. *Med Teach.* 2020;1–10.
9. Wellman B, Haythornthwaite C. *The Internet in everyday life:* John Wiley & Sons;2008.
10. Romano M, Osborne LA, Truzoli R, Reed P. Differential psychological impact of Internet exposure on Internet addicts. *PLoS One.* 2013;8(2):e55162.
11. Aarseth E, Bean AM, Boonen H, Colder Carras M, Coulson M, Das D, et al. Scholars' open debate paper on the World Health Organization ICD-11 Gaming Disorder proposal. *J Behav Addict.* 2017;6(3):267–70.
12. Association AP. *Diagnostic and statistical manual of mental disorders (DSM-5®):* American Psychiatric Pub; 2013.
13. Potenza MN. OR-66: Internet addiction: Diagnostic and classification considerations in the time of DSM-5 and ICD-11. *J Behav Addict.* 2015;4(S1):31–2.
14. Young KS. Internet addiction: The emergence of a new clinical disorder. *Cyberpsychol Behav.* 1998;1(3):237–44.
15. Byun S, Ruffini C, Mills JE, Douglas AC, Niang M, Stepchenkova S, et al. Internet addiction: Metasynthesis of 1996–2006 quantitative research. *Cyberpsychol Behav.* 2009;12(2):203–7.
16. Sinan K. Dijital Okuryazarlık Ve Diğer Değişkenlerle İnternet Bağımlılığı İlişkisinin İncelenmesi. *Uluslararası Yönetim Bilişim Sistemleri ve Bilgisayar Bilimleri Derg.* 2020;4(1):28–41.
17. Balcı Ş, Gülnar B. Üniversite öğrencileri arasında İnternet bağımlılığı ve İnternet bağımlılarının profili. *Selçuk İletişim.* 2009;6(1), 5–22.
18. Kuo Y-C, Walker AE, Schroder KE, Belland BR. Interaction, Internet self-efficacy, and self-regulated learning as predictors of student satisfaction in online education courses. *Internet High Educ.* 2014;20:35–50.
19. Eom SB, Wen HJ, Ashill N. The determinants of students' perceived learning outcomes and satisfaction in university online education: An empirical investigation. *Decis Sci.* 2006;4(2):215–35.
20. Hung M-L, Chou C, Chen C-H, Own Z-Y. Learner readiness for online learning: Scale development and student perceptions. *Comput Educ.* 2010;55(3):1080–90.
21. İlhan M, Çetin B. Çevrimiçi Öğrenmeye Yönelik Hazır Bulunuşluk Ölçeği'nin (ÇÖHBÖ) Türkçe Formunun Geçerlik ve Güvenirlik Çalışması. *Eğitim Teknolojisi Kuram ve Uygulama.* 2013;3(2):72–101.
22. Tang M, Byrne R. Regular versus online versus blended: A qualitative description of the advantages of the electronic modes and a quantitative evaluation. *Int J E-Learning.* 2007;6(2):257–66.
23. Veletsianos G. *Emerging technologies in distance education:* Athabasca University Press;2010.
24. Boyce BF. An update on the validation of whole slide imaging systems following FDA approval of a system for a routine pathology diagnostic service in the United States. *Biotech Histochem.* 2017;92(6):381–9.
25. Nauhria S, Hangfu L. Virtual microscopy enhances the reliability and validity in histopathology curriculum: Practical guidelines. *Med Ed Publish.* 2019;8.
26. Senn GJ. Comparison of face-to-face and hybrid delivery of a course that requires technology skills development. *Journal of Information Technology Education: Research.* 2008;7(1):267–83.
27. Suryadevara V, Adusumalli C, Adusumilli PK, Chalasani SH, Radhakrishnan R. Mental Health Status among the South Indian Pharmacy Students during Covid-19 Pandemic Quarantine Period: A Cross-Sectional Study. *medRxiv.* 2020.
28. Masters K, Ellaway R. *e-Learning in medical education Guide 32 Part 2: Technology, management and design.* *Med Teach.* 2008;30(5):474–89.
29. Choi-Lundberg DL, Al-Aubaidy HA, Burgess JR, Clifford CA, Cuellar WA, Errey JA, et al. Minimal effects of reduced teaching hours on undergraduate medical student learning outcomes and course evaluations. *Med Teach.* 2020;42(1):58–65.
30. Shen L. Computer technology and college students' reading habits. *Chia-Nan Annual Bulletin.* 2006;32:559–72.
31. PrakashYadav G, Rai J. The Generation Z and their social media usage: A review and a research outline. *Global Journal of Enterprise Information System.* 2017;9(2):110–6.
32. Horgan A, Sweeney J. University students' online habits and their use of the Internet for health information. *CIN: Computers, Informatics, Nursing.* 2012;30(8):402–8.

33. Deonisius RF, Lestari I, Sarkadi S. The effect of digital literacy to internet addiction. *Jurnal EDUCATIO. Jurnal Pendidikan Indonesia*. 2019;5(2):71–5.
34. Leung L, Lee PS. Impact of internet literacy, internet addiction symptoms, and internet activities on academic performance. *Soc Sci Comput Rev*. 2012;30(4):403–18.
35. Langarizadeh M, Naghipour M, Tabatabaei SM, Mirzaei A, Vaghar ME. Prediction of internet addiction based on information literacy among students of Iran University of Medical Sciences. *Electronic Physician*. 2018;10(2):6333.
36. Chak K, Leung L. Shyness and locus of control as predictors of Internet addiction and Internet use. *Cyberpsychol Behav*. 2004;7(5):559–70.
37. Li C, Shi X, Dang J. Online communication and subjective well-being in Chinese college students: The mediating role of shyness and social self-efficacy. *Comput Human Behav*. 2014;34:89–95.
38. Panigrahi R, Srivastava PR, Sharma D. Online learning: Adoption, continuance, and learning outcome—A review of literature. *Int J Inf Manage*. 2018;43:1–14.
39. Allen M, Bourhis J, Burrell N, Mabry E. Comparing student satisfaction with distance education to traditional classrooms in higher education: A meta-analysis. *Am J Distance Educ*. 2002;16(2):83–97.
40. Johnson SD, Aragon SR, Shaik N. Comparative analysis of learner satisfaction and learning outcomes in online and face-to-face learning environments. *Journal of Interactive Learning Research*. 2000;11(1):29–49.
41. Croxton RA. The role of interactivity in student satisfaction and persistence in online learning. *J Online Learn Teach*. 2014;10(2):314.
42. Kang M, Im T. Factors of learner-instructor interaction which predict perceived learning outcomes in online learning environment. *J Comput Assist Learn*. 2013;29(3):292–301.
43. Lee SJ, Srinivasan S, Trail T, Lewis D, Lopez S. Examining the relationship among student perception of support, course satisfaction, and learning outcomes in online learning. *Internet High Educ*. 2011;14(3):158–63.
44. Deniz H, Cakir H. Design principles for computer-assisted instruction in histology education: An exploratory study. *J Sci Educ Technol*. 2006;15(5-6):399–408.