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A Comparison of the Digital Divide Across Faculties in Synchronous Online Distance Education

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ABSTRACT

This study aimed to examine first- and second-level digital inequalities experienced by higher education students participating in synchronous distance education during the COVID-19 pandemic and to compare these experiences across different faculties. Additionally, the study explored students' preferences regarding types of distance education, including asynchronous, synchronous, and blended learning. Conducted with a cross-sectional research design, the study included 766 students from seven faculties and vocational schools. Participants were selected through convenience sampling. Data were collected online via a survey developed based on digital inequality indicators, specifically within the context of remote education during the pandemic. The findings revealed that most students had access to at least one technological device for educational purposes during the second academic year of the pandemic. However, approximately one-third of the participants followed their courses solely through smartphones. Smartphone use was more prevalent among students from low-income backgrounds or rural areas. These students typically had limited access to high-speed internet and restricted online connectivity. Participants reported a moderate level of perceived information and communication technology (ICT) proficiency. Male students perceived themselves as significantly more proficient in ICT use than female students. Similarly, students from the Faculties of Education and Engineering reported significantly higher levels of perceived ICT proficiency compared to students from other faculties. Regarding preferences for distance education, the average scores for asynchronous, synchronous, and blended methods were close to the moderate level. A significant difference was found between male and female students: while female students preferred synchronous education, male students favored asynchronous and blended approaches. No significant differences were observed in distance education preferences across faculties.

Eşzamanlı Çevrimiçi Uzaktan Eğitimde Fakülteler Arası Dijital Bölünmelerin Karşılaştırmalı İncelenmesi

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ÖZET

Bu araştırmada, COVID-19 pandemisi sürecinde senkron uzaktan eğitim alan yükseköğretim öğrencilerinin birinci ve ikinci düzey dijital eşitsizliklere maruz kalma durumlarının incelenmesi ve bu deneyimlerin fakültelere göre karşılaştırılması amaçlanmıştır. Ayrıca, katılımcıların tercih ettikleri uzaktan eğitim türleri (asenkron, senkron ve harmanlanmış) de araştırılmıştır. Kesitsel araştırma yöntemine göre yürütülen çalışmaya, yedi farklı fakülte ve meslek yüksekokulundan toplam 766 yükseköğretim öğrencisi katılmıştır. Katılımcılar, kolayda örnekleme yöntemiyle belirlenmiştir. Veriler, dijital eşitsizlik göstergeleri temel alınarak geliştirilen bir anket formu aracılığıyla çevrimiçi toplanmıştır. Bulgular, katılımcıların salgının ikinci

Anahtar Kelimeler:
Dijital bölünme,
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eğitim-öğretim yılında öğrenim amacıyla en az bir teknolojik cihaza erişebildiğini; ancak yaklaşık üçte birinin yalnızca akıllı telefonla derslerini takip ettiğini ortaya koymuştur. Düşük gelir grubunda bulunan veya kırsal bölgelerde yaşayan öğrenciler arasında akıllı telefon kullanımının daha yaygın olduğu belirlenmiştir. Bu öğrencilerin genellikle düşük hızlı internet bağlantısına sahip oldukları ve sınırlı çevrim içi erişim imkânlarına sahip oldukları görülmüştür. Katılımcıların algılanan bilgi ve iletişim teknolojileri (BİT) becerilerinin orta düzeyde olduğu saptanmıştır. Erkek öğrenciler, kadın öğrencilere kıyasla anlamlı düzeyde daha yüksek BİT becerisi algısına sahiptir. Benzer şekilde, Eğitim Fakültesi ve Mühendislik Fakültesi öğrencilerinin, diğer fakültelere kıyasla daha yüksek düzeyde algılanan BİT becerisine sahip oldukları bulunmuştur. Uzaktan eğitim tercihlerine ilişkin analizde, asenkron, senkron ve harmanlanmış yöntemleri tercih eden öğrencilerin puan ortalamalarının orta düzeye yakın olduğu görülmüştür. Cinsiyete göre tercihlerde anlamlı bir farklılık saptanmış; kadın öğrenciler senkron eğitimi, erkek öğrenciler ise asenkron ve harmanlanmış eğitimi daha fazla tercih etmiştir. Fakültelere göre uzaktan eğitim tercihlerinde ise anlamlı bir farklılık gözlenmemiştir.

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INTRODUCTION

Following the declaration of COVID-19 as a global pandemic by the World Health Organization (WHO) on March 11, 2020, countries implemented restrictions on various activities, including social, cultural, artistic, and sporting events. These measures led to the postponement of planned activities. In addition to travel restrictions and social distancing rules, many countries resorted to imposing curfews as a significant precaution. Notably, face-to-face education emerged as one of the most heavily impacted fields due to these restrictions (Reimers & Schleicher, 2020).

Epidemic data published by the United Nations Educational, Scientific and Cultural Organization (UNESCO) revealed that on March 11, 2020, when the global pandemic was officially recognized, approximately 380 million students (21.7%) in 27 countries across the world were affected by these global events (UNESCO, 2020a). As of April 2, 2020, these figures had surged to encompass 1.6 billion students (91%) in 194 countries. Even on June 21, 2020, a significant portion of the student population, approximately 1.09 billion students (62.3%) across 123 countries, continued to grapple with the challenges posed by the ongoing pandemic. Moreover, post-epidemic data estimates that over 1.5 billion students experienced the impact of the pandemic after schools had reopened (UNESCO, 2020a). Over 90% of countries implemented various distance learning policies throughout school closures. Countries have made concerted efforts to ensure uninterrupted education delivery, primarily by leveraging existing online opportunities, especially those provided by Information and Communication Technologies (ICTs) (UNICEF, 2020). COVID-19 marked a significant turning point as it unfolded in an era characterized by the widespread use of social media and Internet technologies. The accessibility of ICTs, particularly Web 2.0 technology, played a pivotal role in enabling the rapid digital transformation necessitated by the pandemic. Nevertheless, challenges emerged regarding individuals' access to these technologies in regions with inadequate infrastructure. Despite migrating many basic education activities to online platforms during this period, studies have revealed that many households lack access to the Internet with sufficient speeds and bandwidth (Srinivasan et al., 2021). For instance, global statistics indicate that approximately 826 million students (50%) lack access to a home computer, while 706 million students (43%) have no access to home internet (UNESCO, 2023). Beyond issues related to infrastructure and connectivity, the familiarity of teachers, students, and administrators with ICT tools and their ability to utilize them also substantially influenced education during this period (Schleicher, 2020). This research focuses on the digital divide within a higher education institution that implemented synchronous distance education during the COVID-19 global pandemic. The study aims to conduct a comparative analysis based on demographic variables, identifying the digital disparities perceived by students across various faculties.

Digital Divide

The digital divide is commonly defined in literature using terms such as digital gap, digital disconnection, and digital poverty (Longoria et al., 2022; Setthasuravich & Kato, 2020). These concepts are primarily employed to distinguish between individuals with sufficient ICT access and those with limited or no access (Soomro et al., 2020). The OECD defines the digital divide as the inequality in access to ICT, particularly the Internet, among individuals, societies, or geographic regions with varying levels of economic development (OECD, 2001). More recently, differences in the quality of access, productivity, and scope of use have been explored within the context of the digital divide (Hargittai, 2021). Digital divides give rise to digital inequality on three levels (DiMaggio & Hargittai, 2001). The first level of inequality examines primary access to technological capabilities, assessing the presence or absence of such access. This form of inequality is particularly pronounced in developing countries. Second-level inequality pertains to the capacity to utilize ICT for specific purposes (Hargittai, 2001). Second-level inequality is prevalent among older individuals, rural residents, and low-income

households. Nevertheless, digital divides are influenced by various factors, including the quality of hardware, software, and network connectivity, autonomy of usage, skills, availability of social support, and the extent and quality of utilization. Research indicates that demographic and socio-economic factors play a role in shaping the level and quality of the first four factors, which, in turn, impact the types of usage (DiMaggio & Hargittai, 2001). This, in turn, results in divergent benefits and opportunities (van Deursen & Helsper, 2015). In this regard, digital divides extend beyond mere access and skills, giving rise to a third level of digital inequality concerning the advantages derived from usage (van Deursen & van Dijk, 2019; Wei et al., 2011).

The digital divide can be rooted in various socio-demographic and socio-economic factors, including income, education, geographic location, age, race/ethnicity and social class (Esteban & Cruz, 2021). The disparities resulting from these factors pose multiple challenges across different sectors and disciplines, including political, economic, and social sciences. Among these, education is particularly highlighted as closely linked to digital divides (Lythreatis et al., 2021). Especially in recent years, the shift to distance learning during the global COVID-19 global pandemic has intensified educational challenges associated with digital inequality in the context of digital inequalities, raising growing concerns (Kloza, 2023).

Related Studies

Numerous studies have investigated the digital divide during the COVID-19 global pandemic. A study involving 264 students at a public university in the Philippines revealed the presence of digital divides among tertiary students, influenced by demographic factors such as location, annual household income, and parents' educational attainment (Esteban & Cruz, 2021). Another study focused on minority students and highlighted their challenges in social connectivity with peers during this period (Hass et al., 2022). According to a survey conducted by the Pew Research Center between January 25 and February 8, 2021, it was observed that Black and Hispanic adults in the United States tended to have less access to computer technology and high-speed internet compared to their White counterparts (Atske & Perrin, 2021). Additionally, van De Werfhorst et al. (2022) examined the digital readiness levels of students and schools during a previous global epidemic, revealing variations in the digital divide based on factors such as migration background, gender, and socio-economic status. For instance, girls from higher socio-economic backgrounds without a migrant background exhibited higher levels of ICT skills compared to their male counterparts from lower socio-economic backgrounds with a migrant background. Engzell et al. (2021) investigated learning losses among secondary school students aged 8 to 11 in the Netherlands during the global pandemic by analyzing national examinations. Their findings indicated that disadvantaged students from less-educated families experienced disproportionate learning losses, with some students facing up to a 60% decline in educational outcomes. Furthermore, Duroisin et al. (2021) identified digital inequalities among teachers in Belgium, particularly related to access to technological equipment and their ability to make effective pedagogical decisions in distance learning. Consequently, it was emphasized that inequalities in teachers' capacity to make pedagogically sound decisions in the distance education environment play a significant role in explaining digital disparities among students.

Purpose of the Research

This study aims to compare the current situations of students across different departments who were engaged in distance education using the synchronous method during the COVID-19 global pandemic period. This comparison will be based on first and second-level digital inequality indicators. Additionally, the research aims to ascertain participants' preferences regarding various distance learning methods.

Research Questions

1. What is the distribution of basic and advanced ICT access among students from different faculties studying through synchronous distance education, as categorized by gender, household income, region of residence, and faculty?
2. How are perceived ICT skills distributed among students from different faculties engaged in synchronous distance education, considering factors such as gender, household income, region of residence, and faculty?
3. Is there a significant difference in ICT skills levels among students from different faculties engaged in synchronous distance education when considering gender and faculty as variables?
4. What are the preferences for distance learning methods among students engaged in synchronous distance education from various faculties, and do these preferences differ significantly based on gender and faculty?

Significance

The short-term ramifications of the COVID-19 global pandemic crisis encompass learning setbacks and increased school dropouts, while the long-term consequences encompass health issues, gender inequality, and digital disparities (UNESCO, 2021; 2020b). To address these disparities, international institutions and organizations such as the United Nations (UN), the World Bank, the International Telecommunication Union (ITU), and the European Union (EU) have undertaken various initiatives and regularly released reports aimed at mitigating these challenges. The UN has called upon all nations to make concerted efforts to reduce digital inequality while encouraging the development of policies aligned with the Sustainable Development Goals (SDGs). Meanwhile, the ITU consistently provides informative statistical data on the prevailing state of digital inequality. These reports frequently underscore the greater challenges developing countries face, particularly those classified as underdeveloped (ITU, 2022). This research seeks to contribute to the evidence base necessary for designing and implementing higher education policies that can reduce the adverse effects of digital disparities—particularly those encountered in synchronous distance education settings.

METHOD

Research Design

This study employed a cross-sectional research design. Cross-sectional studies are observational studies that assess a population at a specific point in time, gathering data from various individuals or groups. The main objective is to explore the relationships between variables at a single time point (Fraenkel et al., 2012).

Participants

In Türkiye, the Ministry of National Education (MNE) and the Council of Higher Education (CoHE), guided by a scientific advisory committee formed during the pandemic, initially closed all schools until April 2020. These closures were later extended until the end of the semester, and ultimately continued for an additional 49 weeks based on the course of the pandemic. To maintain continuity in education, both institutions transitioned primary, secondary, and higher education to distance learning using synchronous and asynchronous methods, as well as non-digital formats such as radio and television. Based on CoHE recommendations, Aksaray University initially implemented asynchronous distance education during the first semester. In the subsequent term, the instruction format was changed

to synchronous. The participants in this study consisted of students who engaged in synchronous learning during the second phase of the pandemic. Participants were selected using convenience sampling. A total of 766 students from seven different faculties participated. More than half were female (n = 461; 60.2%), and the average age was 22.2 (SD = 2.63). Students from the Faculty of Sport Sciences made up 6.9% (n = 53), with the remaining faculties contributing between 14% and 18% of the sample.

Table 1

Descriptive Statistics Regarding Participants' Demographic Characteristics

Category		Distribution (*f*)	%
Age	Mean Age (years)	22.2	-
Gender	Female	461	60.2
	Male	305	39.8
Faculty	Faculty of Education	119	15.5
	Faculty of Arts and Sciences	132	17.2
	Faculty of Economics and Administrative Sciences	142	18.5
	Vocational School	98	12.8
	Faculty of Engineering	115	15.0
	Faculty of Health Sciences	107	14.0
	Sports Science Faculty	53	6.9
Grade Level	1st	48	6.3
	2nd	288	37.6
	3rd	176	23.0
	4th	254	33.2
Place of Residence	City/District Center (Urban)	652	85.1
	Town/Village (Rural)	114	14.9
Household Income	Low	292	38.1
	Middle	350	45.7
	High	124	16.2
	Total	766	100.0

A substantial majority of the participants (n = 652; 85.1%) reported attending their courses from urban areas, including city and district centers. The remaining students (n = 114; 14.9%) participated from rural areas such as towns and villages. Regarding household income, a significant portion of the students (n = 642; 83.8%) were from low- and middle-income backgrounds.

Data Collection Tools

The Digital Inequalities in Emergency Remote Teaching (DIERT) instrument was developed to assess access- and skill-based inequalities experienced by higher education students during the COVID-19-induced shift to remote instruction in Turkey. Although asynchronous methods predominated during the initial phase of the transition, synchronous delivery became the primary mode of instruction in the later stages of the pandemic. The instrument items were refined through an iterative review process conducted by a panel of three domain experts—two instructional designers and one linguist—to ensure content validity and linguistic clarity.

The DIERT instrument comprises four sections with a total of 31 items:

- The first section includes six items gathering demographic information.
- The second section consists of five items assessing basic technology access conditions, targeting first-level digital inequalities.
- The third section measures second-level digital inequalities through 11 items evaluating

participants' perceived ICT competencies.

- The fourth section includes nine items examining participants' perceptions of how technological resources—such as high-speed, unlimited internet access or high-performance computing devices—affect their academic success in remote learning environments.

In accordance with the research objectives and scope, this study utilized the first three sections of the DIERT instrument: demographic characteristics, technology access, and perceived ICT competencies. The fourth section, which examines the impact of technological resources on academic success, has been reserved for a separate study due to its requirement for more comprehensive analysis.

Development and Validation Process

Prior to full-scale implementation, the DIERT instrument underwent pilot testing with 55 students from three faculties, confirming item clarity and establishing preliminary reliability (Cronbach's α = .82–.91). Subsequently, the main validation study was conducted using two independent samples: Exploratory Factor Analysis (EFA) was performed on data from 301 participants, while Confirmatory Factor Analysis (CFA) was conducted on a separate sample of 260 students (total N = 561).

Section 1. Demographic Information

The first section of the DIERT instrument collects essential demographic data from participating students. The variables include gender, age, grade level, academic department, household income, and place of residence. The place of residence variable was specifically designed to capture students' actual living locations during the pandemic period. Since universities were closed due to public health measures, students were no longer residing in dormitories or on-campus housing. Instead, they participated in remote education from their family homes, which were distributed across diverse geographic regions ranging from metropolitan centers to rural villages. This geographic diversity was critical for assessing location-based digital inequalities. All items in this section are categorical or ordinal and were presented using structured survey formats (e.g., multiple-choice and dropdown response options.

Section 2. First-level Digital Inequalities: Basic ICT Access and Quality

The second section investigates first-level digital inequalities by focusing on students' fundamental access to information and communication technologies. This section captures both the presence of technological resources (access dimension) and the perceived adequacy or reliability of these resources (quality dimension). Participants were asked about the types of devices used for academic purposes (e.g., desktop computers, laptops, tablets, smartphones), internet connection types (wired, wireless, or mobile data), internet service providers, perceived internet speed, and data limitations (e.g., unlimited plans versus data quotas). All items in this section were designed as structured survey questions with categorical response options (e.g., multiple-choice and single-selection formats).

Section 3. Second-level Digital Inequalities: Perceived ICT Skills

The third section of the DIERT instrument assesses students' self-perceived digital competencies, consistent with the concept of second-level digital inequality, which refers to individuals' ability to use technology effectively. This section includes 11 items, each rated on a 5-point Likert scale (1 = Not at all competent, 5 = Very competent), to capture students' confidence in performing fundamental ICT-related tasks. Exploratory Factor Analysis (EFA) yielded a Kaiser-Meyer-Olkin (KMO) value of .877

and a significant Bartlett's Test of Sphericity ($\chi^2 = 1714.975$, $df = 55$, $p < .001$), confirming the sample's suitability for factor analysis. Principal Component Analysis with Oblimin rotation revealed a three-factor structure accounting for 71.28% of the total variance. The resulting subscales were:

- Online Information Access and Research Skills (5 items),
- Multimedia Processing Skills (3 items),
- Basic Office Skills (3 items).

Factor loadings ranged from .518 to .940, demonstrating strong construct validity. The three-factor structure was further validated through Confirmatory Factor Analysis (CFA), which produced acceptable model fit indices: $\chi^2/df = 2.867$, CFI = .975, NFI = .962, TLI = .959, GFI = .947, AGFI = .912, RMSEA = .068 (90% CI [.055, .079]), and SRMR = .048.

Internal consistency reliability was assessed using Cronbach's alpha coefficients for each subscale. The results indicated a high level of internal consistency across all subdimensions of the scale. Specifically, the Cronbach's alpha value was .88 for the "Online Information Access and Research Skills" subscale, .89 for the "Multimedia Processing Skills" subscale, and .87 for the "Basic Office Skills" subscale.

Subscale scores were calculated using mean values instead of raw totals to allow standardized comparisons across dimensions of different lengths. While no strict cut-off points were defined, mean values were descriptively interpreted as indicating low competence (< 2.5), moderate competence (2.5–3.5), and high competence (> 3.5).

Section 4: Technology Resources' Effect on Remote Learning

While not directly used in this study, the fourth section is presented here to contextualize the scope of the full DIERT instrument. The fourth section measures students' perceptions of how available technological resources—including internet speed, data capacity, and device performance—impact their success in remote learning environments. Items were rated on a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree), reflecting students' agreement with statements regarding the influence of ICT infrastructure on their academic performance.

Although the scale was initially conceptualized to comprise three subdimensions (Internet Speed, Data Quota, and Hardware Capability), Confirmatory Factor Analysis (CFA) results indicated that the first two dimensions formed a cohesive factor. Consequently, these items were combined into a unified construct labeled "Internet Speed and Data Quota." Construct validity was established through both Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). EFA yielded a Kaiser-Meyer-Olkin (KMO) value of .899 and a significant Bartlett's Test of Sphericity ($\chi^2 = 2801.525$, $df = 36$, $p < .001$), confirming sampling adequacy.

Principal Component Analysis with Oblimin rotation revealed two distinct factors that together accounted for 81.86% of the total variance. The first factor, Internet Speed and Data Quota (6 items) explained 71.86% of the variance, while the second factor, Hardware Capability (3 items), accounted for an additional 10.00%. Factor loadings ranged from .659 to .993, demonstrating strong construct validity. The correlation between factors was .708, indicating a substantial yet conceptually distinct relationship. CFA further validated the two-factor structure, producing strong model fit indices: $\chi^2/df = 5.828$, CFI = .989, NFI = .986, TLI = .976, GFI = .972, AGFI = .925, RMSEA = .079 (90% CI [.065, .095]), and SRMR = .033. Although the χ^2/df ratio slightly exceeded conventional thresholds, the remaining fit indices were well within acceptable ranges, with sample size sensitivity likely accounting for this minor deviation.

Internal consistency reliability of the scale was assessed using Cronbach's alpha coefficients. The overall scale demonstrated excellent reliability ($\alpha = .94$). The subscales also showed high internal consistency, with the Internet Speed and Data Quota subscale yielding $\alpha = .92$, and the Hardware

Capability subscale yielding α = .93.

Higher scores indicate stronger perceptions of the positive influence of technology on remote learning outcomes. Although no formal cut-off values were imposed, scores above 3.5 were descriptively interpreted as indicative of a high perceived impact.

Data analysis

Descriptive analysis, including means and standard deviations, was first performed on the data obtained from the form. Normality was tested using the Shapiro-Wilk test. As the data significantly deviated from a normal distribution ($p < .05$), non-parametric tests were employed.

Findings

The findings are organized into three primary categories. First, results are presented regarding participants' access to and the quality of ICT resources, reflecting first-level digital inequality indicators. Second, findings related to participants' perceived ICT skill levels are reported, addressing second-level digital inequality indicators. Finally, participants' preferences for different distance learning modalities are presented. In addition to the validated scale items, the questionnaire included two single-item measures developed for descriptive purposes. The first item asked participants to indicate the type of learner they most identified with (self-learner, teacher-assisted learner, face-to-face learner, or distance learner); the results of this item are presented in Table 2. The second item asked participants to rate their preference for different distance education modalities (asynchronous, synchronous, or blended); the findings for this item are reported at the end of the results section.

According to the responses, participants most frequently identified as face-to-face learners ($\bar{x}$ = 3.78), followed by teacher-assisted learners ($\bar{x}$ = 3.65) and self-learners ($\bar{x}$ = 3.51). Notably, the mean score for the 'distance learner' identity was lower than other types ($\bar{x}$ = 2.85).

Table 2

Participants' Perceived Learning Characteristics

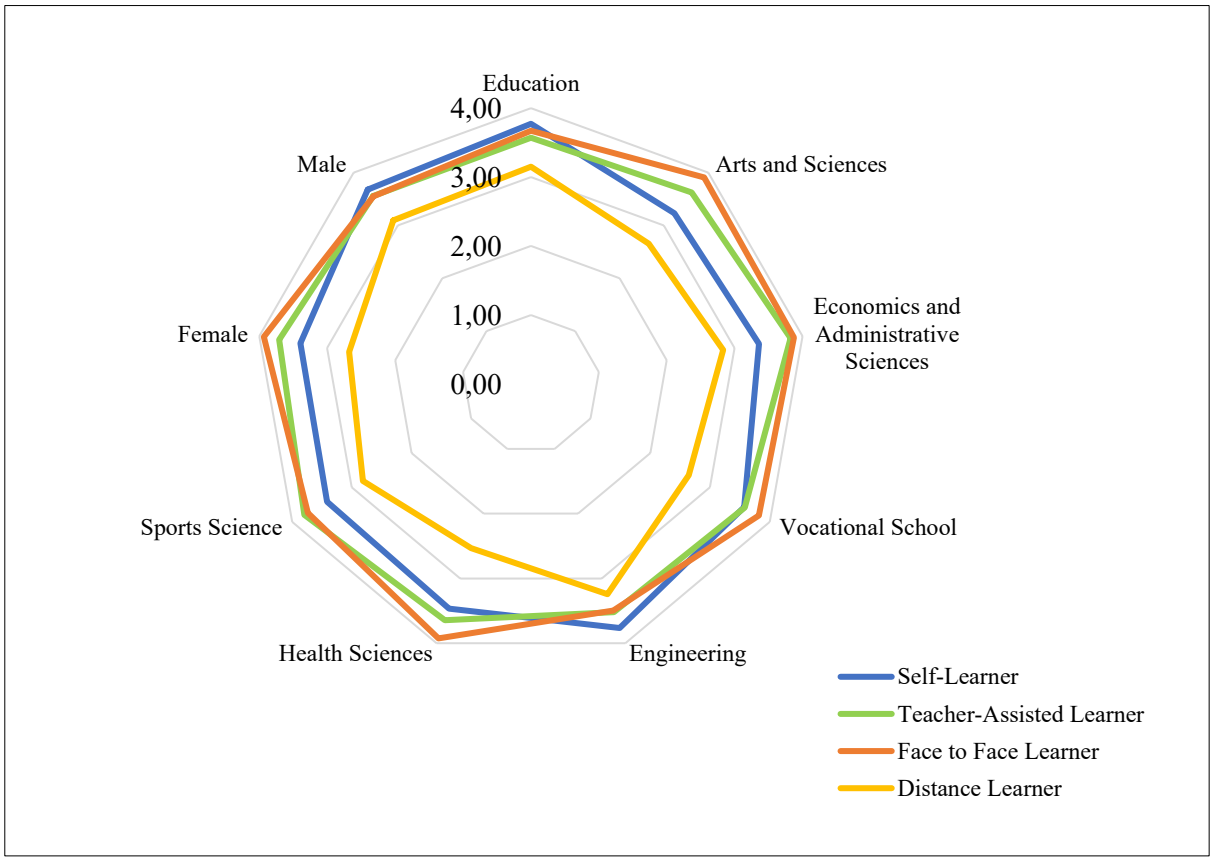
		Self-Learner		Teacher Assisted Learner		Face to Face Learner		Distance Learner	
	n	$\bar{x}$	*SD*	$\bar{x}$	*SD*	$\bar{x}$	*SD*	$\bar{x}$	*SD*
Female	461	3.39	1.17	3.71	1.05	3.93	1.21	2.68	1.38
Male	305	3.68	1.15	3.56	1.12	3.55	1.31	3.10	1.42
Faculty of Education	119	3.77	0.99	3.57	1.13	3.67	1.26	3.15	1.25
Faculty of Arts and Sciences	132	3.23	1.20	3.63	1.09	3.91	1.18	2.66	1.47
Faculty of Economics and Administrative Sciences	142	3.36	1.16	3.82	1.03	3.87	1.25	2.83	1.51
Vocational School	98	3.57	1.22	3.58	1.11	3.82	1.17	2.64	1.44
Faculty of Engineering	115	3.77	1.15	3.52	1.02	3.50	1.37	3.24	1.35
Faculty of Health Sciences	107	3.47	1.19	3.64	1.08	3.93	1.29	2.53	1.26
Sports Science Faculty	53	3.42	1.22	3.79	1.13	3.74	1.33	2.81	1.48
Total	766	3.51	1.17	3.65	1.08	3.78	1.26	2.85	1.41

When learner characteristics were examined by gender, female students reported a stronger preference for face-to-face learning ($\bar{x}$ = 3.93), while their identification with the distance learner profile was notably lower ($\bar{x}$ = 2.68). In contrast, male students were more likely to consider themselves self-learners ($\bar{x}$ = 3.68), which may suggest a tendency toward autonomous learning behaviors. Analysis by academic faculty revealed several distinctive patterns. Students from the Faculties of Education and Engineering reported higher levels of identification with the distance learner profile ($\bar{x}$ = 3.15 and $\bar{x}$ = 3.24, respectively) compared to peers in other faculties. This may reflect greater digital engagement or

adaptability in these fields. Conversely, students in the Faculty of Sports Sciences showed the highest preference for teacher-assisted learning ($\bar{x}$ = 3.79). Face-to-face learning was most strongly endorsed by students in the Faculty of Health Sciences ($\bar{x}$ = 3.93) and Vocational School ($\bar{x}$ = 3.82), suggesting a preference for structured, in-person educational contexts in these disciplines. In terms of teacher-supported learning, students in the Faculty of Economics and Administrative Sciences reported the highest scores ($\bar{x}$ = 3.82). Meanwhile, self-learning was most commonly associated with students from the Faculties of Education and Engineering ($\bar{x}$ = 3.77 for both). As shown in Figure 1, these patterns are visually depicted through a radar chart comparing learner types across gender and faculty categories

Figure 1

Learner Characteristics of Participants by Faculty and Gender



Radar chart illustrating self-identified learning preferences of students across different faculties and by gender (N = 766). Following the overview of learner preferences, the subsequent findings focus on first-level digital inequality indicators, beginning with students' basic access to ICT

Findings on First-Level Digital Divide

Tables 3 and 4 show the results of the first-level digital inequality indicators on the primary and quality level of access to ICT by students studying in synchronous distance education.

Participants' Basic-Level Access to ICT

Participants were asked about the technological devices they used for attending classes and their type of internet connection. Table 3 shows the distribution of students' primary access to ICT by gender, household income, region of residence, and faculty of study.

Table 3

Participants' Primary Access to ICT Tools

		Technology Used								Internet Connection Type			
		Desktop		Laptop		Phone		PC & Phone		Wired & Broadband		Mobile	
		n	%	n	%	n	%	n	%	n	%	n	%
Gender	Female	12	2.6	175	38.0	172	37.3	102	22.1	389	84.4	72	15.6
	Male	40	13.1	118	38.7	106	34.8	41	13.4	246	80.7	59	19.3
	Total	52	6.8	293	38.3	278	36.3	143	18.7	635	82.9	131	17.1
Household Income	Low	15	5.1	81	27.7	151	51.7	45	15.4	207	70.9	85	29.1
	Middle	26	7.4	162	46.3	98	28.0	64	18.3	316	90.3	34	9.7
	High	11	8.9	50	40.3	29	23.4	34	27.4	112	90.3	12	9.7
	Total	52	6.8	293	38.3	278	36.3	143	18.7	635	82.9	131	17.1
Place of Residence	City-District	44	6.7	263	40.3	212	32.5	133	20.4	559	85.7	93	14.3
	Town-Village	8	7.0	30	26.3	66	57.9	10	8.8	76	66.7	38	33.3
	Total	52	6.8	293	38.3	278	36.3	143	18.7	635	82.9	131	17.1
Faculty	Education	9	7.6	42	35.3	41	34.5	27	22.7	107	89.9	12	10.1
	Arts and Science	8	6.1	46	34.8	48	36.4	30	22.7	100	75.8	32	24.2
	Economics & A.	3	2.1	70	49.3	39	27.5	30	21.1	128	90.1	14	9.9
	Vocational Sc.	10	10.2	20	20.4	51	52.0	17	17.3	73	74.5	25	25.5
	Engineering	12	10.4	68	59.1	20	17.4	15	13.0	105	91.3	10	8.7
	Health Sciences	7	6.5	35	32.7	48	44.9	17	15.9	84	78.5	23	21.5
	Sports Sciences	3	5.7	12	22.6	31	58.5	7	13.2	38	71.7	15	28.3
	Total	52	6.8	293	38.3	278	36.3	143	18.7	635	82.9	131	17.1

The participants' access to ICT at a basic level is as follows: 6.8% use desktop computers, 38.3% use notebooks, 36.3% use smartphones and 18.7% use both smartphones and computers to access their courses. While a substantial proportion of students (82.9 %) have access to a wired/broadband network, the remainder (17.1 %) only have access to a mobile network. The use of smartphones is slightly higher among women (37.3%) than men (34.8%) when looking at the use of ICT by gender. Regarding the distribution of male and female participants by type of internet connection, the distribution is similar. Specifically, 84.4% of women and 80.7% of men are connected to the wired/broadband Internet. When considering participants' access to ICT by household income, about half of low-income participants (51.7%) could only use smartphones to access distance learning courses. Regarding household income, around a third (29.1 %) of students in the low-income group and a tenth (9.3 %) of those in the middle and high-income group are connected to the mobile web. It is also observed that students living in rural areas such as towns and villages have higher smartphone usage (57.9%) than those in urban areas (32.5%). Regarding the type of internet connection, 66.7% of students living in towns and villages have access to wired/broadband Internet, while this figure rises to 87.7% in provincial/county centers. Finally, examining the distribution by faculty, there is a tendency for higher smartphone use among students in vocational schools (52%) and sports faculties (58.5%). It is also noteworthy that about half (44.9%) of students in health faculties use smartphones for educational purposes.

Quality level of students' access to ICT

The quality of students' access to ICT was assessed in terms of internet speed and data limitations. At this stage, participants were asked about their Internet service's connection speed and data quota status for course participation. Table 4 shows the breakdown of the quality of students' access to ICT in terms of gender, household income, region of residence and field of study.

Table 4

Participants' access to ICT in terms of quality

		Internet Connection Speed						Internet Quota (Limited-Unlimited) Status			
		Low		Middle		High		Limited Data		Unlimited Data	
		n	%	n	%	n	%	n	%	n	%
Gender	Female	105	22.8	227	49.2	129	28.0	150	32.5	311	67.5
	Male	88	28.9	135	44.3	82	26.9	120	39.3	185	60.7
	Total	193	25.2	362	47.3	211	27.5	270	35.2	496	64.8
Household Income	Low	95	32.5	140	47.9	57	19.5	157	53.8	135	46.2
	Middle	78	22.3	173	49.4	99	28.3	91	26.0	259	74.0
	High	20	16.1	49	39.5	55	44.4	22	17.7	102	82.3
	Total	193	25.2	362	47.3	211	27.5	270	35.2	496	64.8
Place of Residence	City-District	143	21.9	314	48.2	195	29.9	209	32.1	443	67.9
	Town-Village	50	43.9	48	42.1	16	14.0	61	53.5	53	46.5
	Total	193	25.2	362	47.3	211	27.5	270	35.2	496	64.8
Faculty	Education	29	24.4	56	47.1	34	28.6	38	31.9	81	68.1
	Arts and Science	25	18.9	65	49.2	42	31.8	47	35.6	85	64.4
	Economics & A.	32	22.5	70	49.3	40	28.2	45	31.7	97	68.3
	Vocational Sc.	24	24.5	47	48.0	27	27.6	42	42.9	56	57.1
	Engineering	34	29.6	54	47.0	27	23.5	31	27.0	84	73.0
	Health Sciences	36	33.6	48	44.9	23	21.5	42	39.3	65	60.7
	Sports Sciences	13	24.5	22	41.5	18	34.0	25	47.2	28	52.8
	Total	193	25.2	362	47.3	211	27.5	270	35.2	496	64.8

The percentage of participants with a low-speed internet connection is 25.2%, while the percentage of those with a medium-speed connection is 47.3%. Concerning the adequacy of the Internet data, a significant proportion of participants use the Internet to a limited extent (n=270; 35.2%). More than 70% of both male (n=223; 73.2%) and female (n=332; 72.0%) students reported having low to medium internet speeds. When analyzed by household income, more than half of low-income participants (n=157; 53.8%) use limited internet packages. When assessing connection speeds by faculty, similar distributional patterns emerge. Sports science and technical science students use the Internet more than other faculties. In terms of assessing participants' primary access to ICT in terms of the first level of digital inequality indicators, respondents have at least one technological device for educational purposes. Almost all participants have access to the Internet. However, about a third rely exclusively on a smartphone to access course materials. It is worth noting, however, that students from lower-income groups or living in rural areas are more likely to use smartphones to access their course material. These students need more screen size and access to keyboard and mouse tools. Having the smartphone as the primary access tool, especially for low-income or rural students, represents a significant limitation in terms of digital opportunities. Assessing the quality of students' access to ICT according to the first level of digital inequality indicators, the proportion of students with low and medium connection speeds is relatively high. Participants with lower household incomes and students from rural areas, such as towns and villages, have lower internet speeds and tend to use limited internet services. This finding underlines the uneven distribution of high-speed and unlimited internet access according to location and household income.

Findings on Second-Level Digital Divide: Participants' perceived ICT skills

When assessing the participants' perceived skills in using ICT within the framework of the second level of digital inequalities, Participants' overall self-perceived ICT competence was slightly above the moderate level ($\bar{x}$ = 3.50).

Table 5

Descriptive Findings on Participants' ICT Literacy Levels

				Basic Office Skills		Multimedia Processing Skills		Information Access and Research Skills	
		n	*%*	$\bar{x}$	*SD*	$\bar{x}$	*SD*	$\bar{x}$	*SD*
Gender	Female	461	60,2	3,46	1,06	2,89	1,16	3,88	1,00
	Male	305	39,8	3,55	1,20	3,26	1,26	3,92	1,11
Faculty	Education	119	15,5	3,79	,95	3,05	1,16	3,89	1,04
	Arts and Science	132	17,2	3,28	1,12	3,01	1,27	3,90	1,07
	Economics & A.	142	18,5	3,49	1,08	3,06	1,16	3,96	,99
	Vocational Sc.	98	12,8	3,35	1,12	2,98	1,21	3,72	1,09
	Engineering	115	15,0	3,88	1,03	3,20	1,19	4,15	,99
	Health Sciences	107	14,0	3,31	1,22	2,89	1,21	3,72	1,04
	Sports Sciences	53	6,9	3,23	1,23	3,06	1,40	3,81	1,12
	Total	766	100	3,50	1,12	3,04	1,21	3,89	1,04

Looking at the average scores for perceived ICT skills by gender, as shown in Table 5, male participants reported higher mean scores than their female counterparts across all ICT skills domains. When analyzing the data by faculty, it is worth noting that students in the Faculty of Engineering achieve higher average scores in all three perceived ICT skills categories than their counterparts in other faculties. In terms of their ability to access information sources, students show high average scores regardless of demographic factors. Therefore, students have adequate skills to use ICT resources for homework and information purposes. However, the average score for students' skills in using software to prepare audiovisual material is at a medium level, regardless of demographic variables. Differences in mean scores for perceived ICT skills by gender and subject area were assessed using Mann-Whitney U and Kruskal-Wallis H tests to determine the significance of these differences. The results of the difference tests are shown in detail in Tables 6 and 7.

Gender-Based Analysis of Participants' Perceived ICT Skills

Table 6 shows that the participants' ability to use audiovisual software, a subset of perceived ICT skills, differs significantly by gender (p <.05). Men's perceived skills to use audiovisual applications are significantly higher than women's (descriptive results are shown in Table 5).

Table 6

Results of the analysis of the level of perceived ICT skills of the participants by gender[a]

Skills	Basic Office Skills	Multimedia Processing Skills	Information Access and Research Skills
Mann-Whitney U	65717.000	58344.000	66486.000
Wilcoxon W	172208.000	164835.000	172977.000
Z	-1.539	-4.012	-1.291
Asymp. Sig. (2-tailed)	.124	.000	.197

a. Grouping Variable: Gender

Gender disparities in ICT-related fields may stem from entrenched gender roles and societal expectations. Specifically, the societal norm that positions men as inherently more interested and proficient in ICT-related subjects might act as a catalyst for men to actively develop their ICT skills, potentially diminishing women's inclination towards the field. Consequently, such disparities can result in divergent outcomes and varying levels of productivity between genders. Additionally, the historical precedence of men being introduced to ICT at an earlier age, coupled with their earlier access to

technology, could contribute to their advanced development of ICT skills. This early exposure may serve as a contributing factor to the greater proficiency that men tend to exhibit in the ICT domain.

Comparison of ICT Skill Levels Across Faculties

Statistically significant differences were observed among faculties in students' skills in using office applications and accessing information resources ($p < .05$). Following the Kruskal-Wallis test, post-hoc comparisons using Dunn's test were conducted to identify specific group differences.

Table 7

Faculty-based difference test results of the participants' skills in using ICT[a,b]

Skills	Basic Office Skills	Multimedia Processing Skills	Information Access and Research Skills
Kruskal-Wallis H	33.824	3.973	15.516
df	6	6	6
Asymp. Sig.	.000	.680	.017

a. Kruskal Wallis Test
b. Grouping Variable: Fakülte-MYO

Based on the test results, it can be concluded that the mean scores of the students of the faculty of education in the field of the use of office applications are significantly higher than those of the students of the faculties of Sports Sciences, arts and science, vocational school, and health sciences ($p<.05$). The mandatory inclusion of the 'Information Technologies' course in the first year of Education faculties likely contributes to the development of students' ICT skills. Similarly, it is concluded that the mean scores of engineering students' ability to use office applications are significantly higher than those of sports sciences, arts and science, vocational school, and health sciences ($p<.05$). On the other hand, it was found that the mean scores of the students of the Faculty of Engineering in their ability to access information resources are significantly higher than those health sciences and sports sciences ($p<.05$). This finding may be related to the fact that engineering courses typically require more advanced ICT skills.

Students' Distance Learning Preferences by Gender and Faculty

Participants were asked to what extent they would prefer asynchronous, synchronous, and blended distance education formats for the following semester, assuming distance education would continue. The mean scores of the participants for all three distance learning methods are close to the overall average. A significant difference was found between the mean scores of male and female participants. Female participants showed a significantly higher preference for synchronous distance learning compared to male participants. In contrast, male participants preferred asynchronous and blended distance learning at significantly higher levels than female participants.

Table 8

Participants' preferences for distance learning by gender

							Mann-Whitney U		
	Gender	n	Mean Ranks	Sum of Ranks	$\bar{x}$	*SD*	u	z	*p*
Asynchronous Distance Education	Female	461	365.8	168636	3.161	1.387	62144.5	-2.792	0.005
	Male	305	410.3	125126	3.039	1.482			

Synchronous Distance Education	Female	461	398.8	183845	3.139	1.449	63251.5	-2.408	0.016
	Male	305	360.4	109917	2.889	1.410			
Blended Distance Education	Female	461	370.4	170754	3.000	1.464	64262.5	-2.063	0.039
	Male	305	403.3	123008	3.223	1.454			

Several factors may contribute to women's higher preference for synchronous higher education and their higher average scores compared to men. One possible explanation is that women tend to have more disciplined and organized work habits, which are better suited to the regular timetables and fixed hours of synchronous education. Another contributing factor may be women's stronger communication and collaboration skills. It is worth noting that, in synchronous education, students learn through direct interaction with one another. However, preferences for asynchronous and blended learning may vary depending on individual factors. Asynchronous learning can be advantageous for those who require more flexibility in their schedule and the ability to progress at their own pace, as it offers independence in terms of time and location. It has been observed that male participants tend to exhibit more self-directed learning habits, which may explain their preference for asynchronous learning. Furthermore, the blended learning approach, which combines online and face-to-face instruction, may have influenced the preferences of male participants.

When examining the distance learning preferences of participants based on their faculties and vocational education and training (VET) schools, it was found that the average score for all three distance learning methods was roughly the same. While slight variations in the average scores of students from different faculties or VET schools were noted, these differences were not statistically significant.

Table 9

Participants' Distance Education Preferences According to Faculty and Vocational School

						Kruskal Wallis H		
		n	Men Ranks	x̄	*SD*	h	*df*	*p*
Asynchronous Distance Education	Education	119	398.60	3.27	0.127			
	Arts and Science	132	382.88	3.16	0.127			
	Economics & A.	142	372.80	3.09	0.118			
	Vocational Sc.	98	398.21	3.26	0.146	11.76	6	0.68
	Engineering	115	426.31	3.45	0.134			
	Health Sciences	107	339.60	2.87	0.137			
	Sports Sciences	53	348.35	2.93	0.203			
Synchronous Distance Education	Education	119	387.83	3.07	0.131			
	Arts and Science	132	353.95	2.84	0.130			
	Economics & A.	142	379.75	3.01	0.117			
	Vocational Sc.	98	361.84	2.90	0.143	10.047	6	0.123
	Engineering	115	380.15	3.02	0.139			
	Health Sciences	107	435.37	3.38	0.133			
	Sports Sciences	53	400.03	3.15	0.195			
Blended Distance Education	Education	119	391.10	3.15	0.125			
	Arts and Science	132	388.95	3.12	0.132			
	Economics & A.	142	370.63	3.00	0.124			
	Vocational Sc.	98	365.55	2.97	0.145	4.224	6	0.646
	Engineering	115	406.90	3.24	0.138			
	Health Sciences	107	364.76	2.95	0.148			
	Sports Sciences	53	407.58	3.26	0.191			
	Total	766						

Based on the descriptive findings, students from the Faculty of Sports Sciences and the Faculty of Engineering reported the highest average scores for blended distance education ($\bar{x}$ = 3.26). Asynchronous education was most preferred by students in the Faculty of Engineering ($\bar{x}$ = 3.45), while students in the Faculty of Health Sciences expressed the highest preference for synchronous education ($\bar{x}$ = 3.38). Although overall differences in distance education preferences by faculty were not statistically significant, descriptive data suggest that students in the Faculty of Health Sciences demonstrated a notably higher preference for synchronous education ($\bar{x}$ = 3.38) than for asynchronous education ($\bar{x}$ = 2.87).

DISCUSSION

The COVID-19 global pandemic has had a profound impact on the world, particularly on sectors such as health, education, tourism, and the economy. The measures adopted by countries in accordance with the recommendations of the World Health Organization led to significant changes, especially in social life. During this period, all education and training activities were suspended—an unprecedented event in world history. Subsequently, education resumed through distance learning supported by various technologies. Many educational institutions conducted their courses both asynchronously and, later, synchronously through learning management systems.

To participate in these courses, students required access to a reliable internet infrastructure and a device such as a computer, tablet, or smartphone. While some students had access to the necessary infrastructure and technological devices, others faced challenges in meeting these requirements due to factors such as socioeconomic status and regional infrastructure disparities. These challenges contributed to digital inequalities between students, posing a significant barrier to achieving equal opportunities in education.

When evaluating the research results, evidence of digital inequality was found among higher education students engaged in synchronous distance learning during the COVID-19 global pandemic. Furthermore, it was concluded that participants' preferences for distance learning varied according to demographic variables. Although all participants had access to at least one technological device when schools were closed, it was observed that approximately one-third of the population could only attend classes using their smartphones. The use of smartphones was found to be more prevalent among students from low-income groups and rural areas. Similarly, students from low-income groups and those living in rural areas were found to have lower internet speeds and limited internet access. A study by Yolcu (2020) indicated that more than half of the students struggle with internet access quality and lack a computer to participate in classes. A review of the literature also highlights the lack of equipment and infrastructure as one of the primary issues during the pandemic period (Saygı, 2021; Tirtanawati, 2021). The findings of this research show that these factors continue to have a negative impact on students, even in higher education. However, it has been confirmed that first-level digital inequalities remain prevalent in higher education, indicating that factors such as location and socioeconomic status continue to influence the digital divide. These findings align with many studies in the existing literature (Aissaoui, 2021; Esteban & Cruz, 2021; Laufer et al., 2021).

The research also found that the perceived ICT skills of higher education students were generally average. Furthermore, significant differences in perceived ICT skills were observed according to gender and faculty. Male students demonstrated higher perceived skills than female students in graphic-audio and video editing, but no significant gender differences were found in the use of software and access to information resources. This suggests that the digital literacy levels of higher education students, irrespective of gender, are relatively homogeneous. However, it also indicates that ICT skills continue

to vary by gender in areas that demand more technical expertise (Qazi et al., 2021; Scheerder et al., 2017). These gender differences may be influenced by gender roles and societal expectations. It is important to emphasize, however, that these differences are not solely attributable to biological or stereotypical gender differences. Education systems can mitigate this inequality by promoting gender equality and providing girls with opportunities to develop ICT skills early on. Moreover, educational policies and programs that challenge gender stereotypes can also play a crucial role in addressing this issue. According to the research findings, ICT skills also vary depending on the faculty. Students from the faculties of engineering and education were found to possess higher ICT skills compared to students from other faculties. This can be attributed to the higher concentration of ICT-related courses within these faculties.

Research indicates that preferences for distance learning vary according to gender, with studies in literature supporting this conclusion (Qazi et al., 2021). While women tend to prefer synchronous education, men are more inclined toward asynchronous and blended learning formats. Based on these findings, higher education institutions should offer a variety of distance learning methods that cater to different preferences and abilities, thus creating a learning environment that meets the diverse needs of all students. Additionally, the research shows that preferences for distance learning differ across faculties. Students in engineering and education faculties are more likely to prefer synchronous, asynchronous, and blended distance learning, whereas students in health and sports faculties tend to favor face-to-face and synchronous education.

Conclusion

The Covid-19 pandemic has exacerbated digital inequalities among higher education students. Additionally, students' preferences for distance learning methods vary based on demographic factors. The findings of this study underscore the presence of digital inequalities, which remain a significant barrier to equal opportunities in education. One of the key factors contributing to these inequalities is the lack of internet infrastructure and technological devices, particularly in low-income and rural areas. In conclusion, this study highlights the persistence of digital inequalities in higher education. The results suggest that higher education institutions should shift towards customized distance learning approaches that cater to the unique needs of different faculties and students, rather than adopting a one-size-fits-all model. Furthermore, efforts are needed to mitigate digital inequalities through policies and initiatives that promote gender equality. In situations that require school closures, such as pandemics, higher education institutions should implement measures to address the socio-economic disparities related to students' locations and household incomes, ensuring equal opportunities for all in distance learning.

Limitations:

Students lacking ICT access may be underrepresented due to the online nature of the survey.

Research Highlights:

- Learner profiles differ by faculty and gender; Education and Engineering students are more likely to identify as distance learners.
- Male students report higher perceived ICT skills, especially in technically demanding tasks.
- ICT competence varies by discipline; students in Health, Sports, and Arts and Sciences show lower proficiency.
- Multimedia processing skills are weak across all demographics, highlighting a shared area for improvement.
- Distance learning preferences vary by gender; women prefer synchronous, men favor asynchronous and blended formats.

Ethical Approval Statement

This study was approved by the Aksaray University Human Research Ethics Committee (Approval No: 2020/06-84).

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Author Contributions

Özkaya, M.: Conceptualization, Methodology, Formal Analysis, Investigation, Data Curation, Writing – Original Draft, Visualization.
Hebebci, M.T.: Conceptualization, Writing – Review & Editing.
Kaleci, F.: Conceptualization, Writing – Review & Editing.

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