

The effect of SARS-CoV-2 pandemic on anxiety levels and attitudes towards e-learning among sports sciences students

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

Abstract

Background and Study Aim The COVID-19 pandemic has led to significant changes in education and teaching processes, particularly affecting application-based disciplines such as sports science. This study aimed to examine the relationship between COVID-19-related anxiety and attitudes toward e-learning among sports sciences students.

Material and Methods The study was conducted using a cross-sectional design with 2,479 students from 14 state universities in Turkey. Data were collected using the Coronavirus Anxiety Scale (CAS) and the Test of E-Learning Related Attitudes Scale (TELRA), and responses were gathered through online surveys. Parametric statistical analyses (t-test, correlation) were performed using SPSS at a significance level of $p < 0.05$.

Results Anxiety associated with the SARS-CoV-2 pandemic led to significant changes in the e-learning attitudes of sports sciences students. Students with higher levels of anxiety exhibited stronger tendencies toward technology use and perceived usefulness, whereas only limited differences were noted in satisfaction and motivation. Female students reported higher levels of symptoms and anxiety, while those who engaged in regular exercise demonstrated lower anxiety levels. Interestingly, within the high-anxiety group, students who did not regularly participate in exercise displayed more favorable e-learning attitudes. These findings suggest that anxiety may strengthen the inclination toward digital learning; however, this tendency does not always align with motivational commitment.

Conclusions The e-learning attitudes of sports sciences students during the pandemic were influenced by factors such as technological competence, psychological state, gender, exercise habits, and the requirements of practical courses. The findings highlight the importance of designing hybrid and flexible learning models in times of crisis, in a manner that integrates psychological support with pedagogical needs.

Keywords: academic motivation, anxious, digital literacy, learning, pedagogy, social isolation, COVID-19

Introduction

The outbreak, which began with the detection of pneumonia clusters in Wuhan, People's Republic of China, rapidly evolved into a global pandemic from late 2019 onward. As of 7 March 2023, Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) had infected more than 750 million individuals worldwide [1]. To curb the spread of the pandemic, preventive measures such as social distancing, curfews, quarantine, and isolation were implemented in many countries, including Turkey [2]. The pandemic was not only a biological crisis; it also profoundly affected social lifestyles, institutional functioning, and individuals' mental health [3].

During the pandemic, educational activities were severely affected. Face-to-face instruction was suspended, and teaching was shifted to remote learning through digital platforms [4, 5]. This

transition led to uncertainty, loss of motivation, and professional concerns in students, particularly regarding their academic and social experiences. Physical isolation, lack of social interaction, and the overall atmosphere of uncertainty contributed to an increase in symptoms such as anxiety, depression, and burnout among many students [6, 7]. Lee reported that university students, who have a heightened need for social belonging and physical activity due to their developmental characteristics, were more profoundly affected by this process [8].

With the onset of the pandemic, the shift from face-to-face, interaction-based learning environments to digital platforms triggered various cognitive and emotional responses in certain student populations. These included distraction, lack of motivation, low engagement, and fear of academic failure [9]. The effects were particularly pronounced in fields with a strong emphasis on practical training components. The field of sports sciences, which encompasses motor skills, physical

education-based courses, and field applications that rely heavily on experiential learning, was among the disciplines most affected by the transition to digital platforms [10, 11]. Students' psychological states during the pandemic also shaped their attitudes toward online learning practices. Increased levels of anxiety were associated with negative learning outcomes, such as resistance to technology, digital alienation, and dissatisfaction with learning [12, 13]. In this context, it is essential to take students' psychological processes into account in order to understand their attitudes toward distance education systems [14].

The psychological effects of COVID-19 on university students have been examined in many countries. In China, 24.9% of students were reported to have anxiety disorders [15]. In Bangladesh and the United States, high rates of depression and anxiety symptoms were observed [16, 17]. Similar findings were also reported in Russia, Belarus, and Turkey [18, 19, 20]. However, studies examining the implications of these psychological effects on attitudes toward e-learning remain relatively limited [21, 22, 23].

Research in the literature has primarily focused on disciplines such as engineering, social sciences, and health sciences, which are largely based on the transfer of theoretical knowledge [24, 25]. By contrast, sports sciences represent a distinctive field that involves a high degree of physical interaction, bodily performance, and motor skill-based learning processes, with many courses requiring practical application. Educational activities in this discipline encompass not only theoretical knowledge such as movement analysis, training science, sports physiology, biomechanics, and teaching methods in physical education but also laboratory work, field applications, and instructional techniques requiring direct, face-to-face interaction. Accordingly, face-to-face learning environments are fundamental in sports sciences not only for the transmission of knowledge but also for observation, modeling, feedback exchange, and experiential learning. Since sports sciences include cognitive, affective, and psychomotor domains of learning, digital learning environments often fail to sufficiently support this holistic educational experience. This shortcoming has led to reduced pedagogical satisfaction among students, as well as declines in psychological variables such as sense of belonging, motivation, and academic self-efficacy [26, 27].

In this regard, understanding the educational and psychological implications of isolation among sports sciences students during the pandemic is of critical importance. Such understanding is essential not only for ensuring remote access during crises but also for developing flexible and hybrid learning models that prioritize movement and interaction. Against this background, the present study focuses

on sports sciences students, whose psychological health during COVID-19 and attitudes toward e-learning have been only sparsely investigated. This study aimed to examine the relationship between COVID-19-related anxiety and attitudes toward e-learning among sports sciences students.

Research Question and Hypotheses

The central research question of this study is: "Do the anxiety levels of sports sciences students during the COVID-19 pandemic significantly affect their attitudes toward e-learning?"

H₁: The COVID-19-related anxiety levels of sports sciences students significantly influence their attitudes toward e-learning. H1a: COVID-19-related anxiety levels and e-learning attitudes of sports sciences students differ significantly by gender.

H1b: COVID-19-related anxiety levels and e-learning attitudes of sports sciences students differ significantly depending on whether they engage in regular exercise.

H1c: There are significant differences in e-learning attitudes between students with and without COVID-19-related anxiety. H1d: There are significant relationships between COVID-19-related anxiety and both overall attitudes toward e-learning and its sub-dimensions.

Materials and Methods

Participants

The population of this research consisted of undergraduate students enrolled in sports sciences programs at 14 public universities in Turkey during the 2020–2021 academic year. The required sample size representing the population was calculated using G*Power software (v3.1.9.1). With a statistical power of 95% ($\alpha = 0.01$) and an effect size of 0.2, a minimum of 2,008 students was required. Accordingly, the study group consisted of 2,479 undergraduate students who voluntarily participated and were selected through simple random sampling. Of these participants, 54.6% were male ($n = 1,354$) and 45.4% were female ($n = 1,125$). Regarding age distribution, 44.2% were between 21–23 years ($n = 1,096$), 42.1% were between 18–20 years ($n = 1,043$), and 13.7% were 24 years or older ($n = 340$). The descriptive statistics of participants' demographic characteristics are presented in Table 1.

Ethical Considerations

Ethical approval for the study was obtained from the Ethics Committee of Bayburt University in its 14th session on 25 September 2020 (Decision No: 2020/80). All procedures performed in this study were conducted in accordance with the 1964 Declaration of Helsinki and its later amendments. The data collected within the scope of the research were gathered, analyzed, and reported in compliance with ethical principles.

Table 1. Descriptive Statistics of Participants' Demographic Characteristics

Variables	Groups	n	%
Sex	Male	1354	54.6
	Female	1125	45.4
Age	18–20 years	1043	42.1
	21–23 years	1096	44.2
	24 or older	340	13.7
Department	Coaching Education	649	26.2
	Physical Education and Sport	795	32.1
	Recreation	462	18.6
	Sport Management	573	23.1
Do you have a computer?	Yes	1054	42.5
	No	1425	57.5
Internet access	Yes	1860	75.0
	Partially available	619	25.0
E-learning tools	Computer	600	24.2
	Mobile devices	1879	75.8
Average weekly time spent on e-learning systems	1–12 hours	884	35.7
	13–24 hours	600	24.2
	25–35 hours	445	18.0
	36 hours or more	550	22.2
Exercise regularly	Yes	1420	57.3
	No	1059	42.7

Research Design

In this study, a non-experimental, cross-sectional survey design, one of the quantitative research methods, was employed. All data were collected remotely via a digital platform due to the global restrictions imposed by the SARS-CoV-2 (COVID-19) pandemic. Cross-sectional survey studies are a type of scientific investigation that provide descriptive insights for future research and offer researchers different perspectives [28]. For data collection, a Demographic Information Form was used alongside two standardized instruments. The Coronavirus Anxiety Scale (CAS), originally developed by Lee and adapted into Turkish by Evren et al., was administered [29, 30]. Additionally, the Test of E-Learning Related Attitudes Scale (TELRA), developed by Kisanga and Ireson and adapted into Turkish by Biçer, was utilized [31, 32].

Instruments

Coronavirus Anxiety Scale (CAS). The CAS is a self-report mental health screening tool designed to assess dysfunctional anxiety specifically associated with the SARS-CoV-2 (COVID-19) pandemic crisis. It was developed to assist clinicians and researchers in effectively identifying individuals whose functioning is impaired due to coronavirus-related anxiety. The scale consists of five items, each addressing symptoms of dizziness, sleep

disturbance, tonic immobility, appetite loss, and nausea associated with COVID-19-related anxiety. Respondents rate their experiences over the past two weeks on a 5-point Likert scale ranging from 0 (not at all) to 4 (nearly every day over the last two weeks), yielding a total score between 0 and 20. Higher scores on individual items or the total scale indicate problematic symptoms that may warrant further evaluation and/or clinical intervention. The CAS employs cutoff scores as follows: ≤ 4 for normal individuals, ≥ 5 for those with dysfunctional anxiety related to COVID-19, and ≥ 9 for high-risk groups, that is, individuals for whom clinical treatment may be recommended due to anxiety [29, 33]. In terms of reliability, Lee reported coefficients ranging from 0.81 to 0.93, while the Turkish adaptation by Evren et al. yielded coefficients between 0.66 and 0.81. In the present study, reliability coefficients ranged between 0.72 and 0.80 [29, 30].

Test of E-Learning Related Attitudes Scale (TELRA). TELRA was developed to assess the attitudes of undergraduate students toward e-learning. The instrument consists of 23 items and has a four-factor structure encompassing tendency to use technology, satisfaction, motivation, and usefulness. Attitudes toward e-learning are measured using a 4-point Likert scale for each item, ranging from 1 (Strongly Disagree), 2 (Disagree), 3 (Agree), to 4 (Strongly Agree). The total score obtainable from

the TELRA ranges between 23 and 92, with each sub-dimension also evaluated separately. In the study by Kisanga and Ireson, the reliability coefficients of the TELRA ranged between 0.65 and 0.78 [31]. In the Turkish adaptation conducted by Biçer, reliability coefficients ranged from 0.68 to 0.75. In the present study, the reliability coefficients were found to range between 0.76 and 0.87 [32].

Statistical Analysis

For the analysis of the data obtained in the study, the statistical package program SPSS (v23) was employed. Initially, the distributions of demographic variables, the scores obtained from the measurement instruments, and skewness–kurtosis values were examined. Based on the criterion that skewness and kurtosis values within the range of -2.5 to $+2.5$ indicate normal distribution, including the subfactors of CAS and TELRA, parametric tests were applied for comparative analyses [34, 35]. Independent-samples *t*-tests were used for two-group comparisons. To determine the correlational relationships between CAS and TELRA, the Correlate procedure was utilized. For the interpretation of the findings, the level of statistical significance was set at $p < 0.05$.

Results

In this section, the statistical findings regarding the anxiety levels of sports sciences students related to SARS-CoV-2 (COVID-19) and their attitudes toward e-learning are presented. In addition, e-learning attitudes were compared according to factors such as regular exercise during the pandemic, COVID-19-related anxiety, and gender. The correlational relationships between CAS and TELRA were also examined. Descriptive findings of sports sciences students' e-learning attitudes according to their COVID-19-related anxiety levels are presented in Table 2.

In Table 2, students with low anxiety levels (CAS ≤ 4) scored lower on symptoms such as dizziness, sleep problems, tonic immobility, appetite loss, and abdominal distress, whereas those with high anxiety levels (CAS ≥ 5) showed a marked increase in these symptoms. Approximately one-quarter of the students (26.3%) scored above the anxiety cutoff point, indicating the presence of COVID-19-related anxiety. The low-anxiety group demonstrated moderately positive attitudes toward e-learning overall and across sub-dimensions, while the high-anxiety group reported higher overall attitudes

Table 2. Descriptive Statistics for CAS and TELRA ($n = 2479$)

Anxiety level	Factors	Min.	Max.	Mean $\pm$ SD	Skewness	Kurtosis
≤ 4 ($n = 1,828$; 73.7%)	Dizziness	0	4	0.26 ± 0.59	1.432	-0.563
	Sleep problems	0	4	0.24 ± 0.54	1.477	-0.601
	Tonic immobility	0	4	0.22 ± 0.48	1.224	-0.421
	Appetite loss	0	4	0.18 ± 0.46	1.791	-0.815
	Abdominal distress	0	4	0.10 ± 0.36	1.244	-0.426
	CAS	0	4	1.02 ± 1.34	1.019	-0.325
	Tendency to use technology	6	24	13.53 ± 3.64	0.282	0.157
	Satisfaction	5	20	12.06 ± 3.19	-0.164	-0.179
	Motivation	6	24	13.15 ± 4.13	0.172	-0.390
	Usefulness	6	24	16.01 ± 3.79	-0.088	0.044
	TELRA	23	92	54.76 ± 6.87	-0.406	1.755
≥ 5 ($n = 651$; 26.3%)	Dizziness	0	4	1.93 ± 1.23	0.263	-0.780
	Sleep problems	0	4	2.05 ± 1.14	0.244	-0.681
	Tonic immobility	0	4	1.70 ± 1.16	0.414	-0.590
	Appetite loss	0	4	1.78 ± 1.22	0.332	-0.759
	Abdominal distress	0	4	1.36 ± 1.20	0.662	-0.407
	CAS	5	20	8.84 ± 3.72	1.179	-0.929
	Tendency to use technology	6	24	15.26 ± 3.79	0.089	-0.056
	Satisfaction	5	20	11.92 ± 3.51	-0.042	-0.374
	Motivation	6	24	12.88 ± 4.50	0.302	-0.445
	Usefulness	6	24	17.02 ± 3.99	-0.266	-0.121
	TELRA	23	92	57.06 ± 7.00	0.417	1.890

CAS = Coronavirus Anxiety Scale; TELRA = Test of E-Learning Related Attitudes Scale; ≤ 4 = Non-anxious; ≥ 5 = Anxious

toward e-learning. In particular, perceptions of tendency to use technology and usefulness of e-learning were significantly stronger in the high-anxiety group. By contrast, no notable differences were observed between the groups in terms of satisfaction or motivation. These findings indicate that pandemic-related anxiety influenced students' inclination toward digital learning environments; however, this inclination did not directly translate into higher motivation or satisfaction.

COVID-19-related anxiety symptoms were also found to differ significantly by gender ($p < .05$) (Table 3).

In Table 3, female students reported higher symptom scores than male students in physiological indicators such as dizziness, sleep problems, tonic immobility, appetite loss, and abdominal distress. This suggests that women experienced pandemic-

related anxiety more intensely. Moreover, CAS scores, which assess overall anxiety, were also significantly higher among female students. The effect size values (Cohen's d) ranged from small to medium across all symptoms, with overall anxiety showing an effect approaching the medium range. These findings suggest that gender may be a determining factor in psychological responses to the pandemic.

As shown in Table 4, students' COVID-19-related anxiety symptoms differed significantly depending on whether or not they engaged in regular exercise ($p < .05$).

In Table 4, students who maintained regular exercise reported lower scores for dizziness, sleep problems, tonic immobility, appetite loss, abdominal distress, and lower CAS averages compared to those who did not exercise. Although these differences were statistically significant, the effect sizes were

Table 3. Independent-samples t-test results for COVID-19-related anxiety by gender (Male $n = 1354$; Female $n = 1125$)

Anxiety Symptom	Gender	Mean $\pm$ SD	df	t	p	Cohen's d
Dizziness	Male	0.56 $\pm$ 0.99	2477	-6.949	.000	$\approx$ 0.301
	Female	0.87 $\pm$ 1.17				
Sleep problems	Male	0.57 $\pm$ 0.99	2477	-7.281	.000	$\approx$ 0.317
	Female	0.89 $\pm$ 1.18				
Tonic immobility	Male	0.47 $\pm$ 0.87	2477	-7.733	.000	$\approx$ 0.349
	Female	0.77 $\pm$ 1.06				
Appetite loss	Male	0.47 $\pm$ 0.91	2477	-6.817	.000	$\approx$ 0.292
	Female	0.76 $\pm$ 1.12				
Abdominal distress	Male	0.35 $\pm$ 0.82	2477	-5.205	.000	$\approx$ 0.284
	Female	0.54 $\pm$ 0.95				
CAS	Male	2.44 $\pm$ 3.78	2477	-8.543	.000	$\approx$ 0.456
	Female	3.85 $\pm$ 4.33				

CAS = Coronavirus Anxiety Scale

Table 4. Independent-samples t-test results for COVID-19-related anxiety by regular exercise (Yes $n = 1420$; No $n = 1059$)

Anxiety Symptom	Exercise	Mean $\pm$ SD	df	t	p	Cohen's d
Dizziness	Yes	0.64 $\pm$ 1.03	2477	-2.804	.005	$\approx$ 0.143
	No	0.77 $\pm$ 1.17				
Sleep problems	Yes	0.63 $\pm$ 1.01	2477	-4.655	.000	$\approx$ 0.212
	No	0.84 $\pm$ 1.19				
Tonic immobility	Yes	0.56 $\pm$ 0.92	2477	-2.564	.012	$\approx$ 0.140
	No	0.67 $\pm$ 1.03				
Appetite loss	Yes	0.52 $\pm$ 0.92	2477	-4.438	.000	$\approx$ 0.230
	No	0.71 $\pm$ 1.12				
Abdominal distress	Yes	0.38 $\pm$ 0.81	2477	-3.275	.001	$\approx$ 0.167
	No	0.50 $\pm$ 0.97				
CAS	Yes	2.76 $\pm$ 3.73	2477	-4.399	.000	$\approx$ 0.279
	No	3.50 $\pm$ 4.51				

CAS = Coronavirus Anxiety Scale

small. This suggests that regular exercise may have a mitigating effect on pandemic-related anxiety, though the magnitude of this effect appears to be limited.

Significant differences in students' e-learning attitudes were identified in relation to anxiety associated with the SARS-CoV-2 pandemic ($p < .05$). Students with higher levels of anxiety ($CAS \geq 5$) demonstrated notably higher scores in the dimensions of tendency to use technology and usefulness, as well as in overall attitudes toward e-learning (TELRA). By contrast, although differences in satisfaction and motivation toward e-learning were statistically significant between groups, both the absolute differences and effect sizes were small. This suggests that students with elevated anxiety levels were more inclined toward e-learning systems; however, this inclination was only weakly associated with emotional or motivational commitment. Overall, the findings indicate that the psychological pressure and anxiety induced by the COVID-19 pandemic may have triggered a more functional and instrumental orientation toward e-learning (Table 5).

According to Table 6, when COVID-19 anxiety and gender variables were examined together, certain attitudes toward e-learning showed significant differences ($p < .05$). Female students, both in the low- and high-anxiety groups, reported higher

levels of tendency to use technology and perceived usefulness compared to male students. Male students, on the other hand, demonstrated higher levels of motivation. In terms of overall TELRA scores, female students scored higher; however, the fact that effect sizes across all differences were small suggests that, when considered alongside anxiety, gender exerts a limited yet statistically significant influence on e-learning attitudes.

When COVID-19 anxiety and regular exercise status were considered together, statistically significant differences were observed in students' attitudes toward e-learning ($p < .05$). In both the anxious and non-anxious groups, students who did not engage in regular exercise reported higher levels of tendency to use technology, satisfaction, motivation, and perceived usefulness toward e-learning. These differences were particularly pronounced among individuals with higher anxiety levels ($CAS \geq 5$), for whom the overall TELRA score, reflecting general attitudes toward e-learning, was also significantly higher among non-exercising students. These findings suggest that, despite the positive effects of exercise on psychological well-being, positive attitudes toward e-learning may vary in different directions depending on the level of anxiety, underscoring the need for a multidimensional evaluation of this relationship (Table 7).

Table 5. Independent-samples t-test results comparing e-learning attitudes by anxiety levels

E-Learning Attitudes	≤ 4 (n = 1828)	≥ 5 (n = 651)	df	t	p	Cohen's d
Tendency to use technology	13.53 $\pm$ 3.64	15.26 $\pm$ 3.79	2477	-10.296	.001	$\approx$ 0.415
Satisfaction	12.06 $\pm$ 3.19	11.92 $\pm$ 3.51	2477	0.905	.001	$\approx$ 0.087
Motivation	13.15 $\pm$ 4.13	12.88 $\pm$ 4.50	2477	1.437	.006	$\approx$ 0.171
Usefulness	16.01 $\pm$ 3.79	17.00 $\pm$ 3.99	2477	-5.481	.001	$\approx$ 0.230
TELRA	54.76 $\pm$ 6.87	57.06 $\pm$ 7.00	2477	-7.222	.001	$\approx$ 0.294

TELRA = Test of E-Learning Related Attitudes Scale; ≤ 4 = Non-anxious; ≥ 5 = Anxious

Table 6. Independent-samples t-test results comparing e-learning attitudes by COVID-19 anxiety and gender

CAS	E-Learning Attitudes	Male	Female	t	p	Cohen's d
≤ 4	Tendency to use technology	13.19 $\pm$ 3.61	14.02 $\pm$ 3.62	-4.829	.001	$\approx$ 0.293
	Satisfaction	12.11 $\pm$ 3.17	11.98 $\pm$ 3.20	0.896	.371	$\approx$ 0.110
	Motivation	13.41 $\pm$ 4.18	12.79 $\pm$ 4.04	3.154	.002	$\approx$ 0.089
	Usefulness	15.72 $\pm$ 3.79	16.43 $\pm$ 3.75	-3.981	.001	$\approx$ 0.190
	TELRA	54.44 $\pm$ 6.89	55.23 $\pm$ 6.81	-2.436	.015	$\approx$ 0.286
≥ 5	Tendency to use technology	14.78 $\pm$ 3.84	15.59 $\pm$ 3.73	-2.710	.007	$\approx$ 0.210
	Satisfaction	12.11 $\pm$ 3.54	11.78 $\pm$ 3.49	1.153	.249	$\approx$ 0.089
	Motivation	13.41 $\pm$ 4.74	12.50 $\pm$ 4.30	2.507	.012	$\approx$ 0.200
	Usefulness	16.55 $\pm$ 4.02	17.31 $\pm$ 3.95	-2.399	.017	$\approx$ 0.190
	TELRA	56.86 $\pm$ 7.58	57.20 $\pm$ 6.57	-0.607	.544	$\approx$ 0.063

CAS = Coronavirus Anxiety Scale; TELRA = Test of E-Learning Related Attitudes Scale; ≤ 4 = Non-anxious; ≥ 5 = Anxious

Table 7. Independent-samples t-test results comparing e-learning attitudes by COVID-19 anxiety and regular exercise

CAS	E-Learning Attitudes	Yes	No	t	p	Cohen's d
≤ 4	Tendency to use technology	13.20 ± 3.60	14.01 ± 3.65	-4.613	.001	≈ 0.220
	Satisfaction	11.50 ± 3.31	12.38 ± 3.05	5.243	.001	≈ 0.248
Yes (n = 1086)	Motivation	12.62 ± 4.11	13.53 ± 4.16	4.763	.001	≈ 0.220
No (n = 742)	Usefulness	15.73 ± 3.72	16.42 ± 3.80	-3.804	.001	≈ 0.180
	TELRA	53.03 ± 5.97	55.33 ± 6.93	0.759	.281	≈ 0.027
≥ 5	Tendency to use technology	14.72 ± 3.84	15.82 ± 3.64	-3.743	.001	≈ 0.293
	Satisfaction	11.58 ± 3.58	13.23 ± 3.42	2.372	.018	≈ 0.190
Yes (n = 334)	Motivation	12.41 ± 4.50	14.32 ± 4.45	2.611	.009	≈ 0.200
No (n = 317)	Usefulness	15.55 ± 3.82	17.92 ± 4.13	-3.243	.001	≈ 0.258
	TELRA	54.21 ± 6.82	61.29 ± 7.01	0.439	.001	≈ 0.063

CAS = Coronavirus Anxiety Scale; TELRA = Test of E-Learning Related Attitudes Scale; ≤ 4 = Non-anxious; ≥ 5 = Anxious

Table 8. Correlation results between CAS and TELRA

Factors	Tendency to use technology	Satisfaction	Motivation	Usefulness	TELRA
Dizziness	r = .194**, p = .000	r = -.014, p = .496	r = -.025, p = .209	r = .102**, p = .000	r = .139**, p = .000
Sleep problems	r = .244**, p = .000	r = -.067**, p = .001	r = -.086**, p = .000	r = .153**, p = .000	r = .132**, p = .000
Tonic immobility	r = .247**, p = .000	r = -.038, p = .061	r = -.064**, p = .001	r = .106**, p = .000	r = .135**, p = .000
Appetite loss	r = .227**, p = .000	r = -.053**, p = .009	r = -.069**, p = .001	r = .116**, p = .000	r = .120**, p = .000
Abdominal distress	r = .212**, p = .000	r = -.026, p = .204	r = -.057**, p = .004	r = .091**, p = .000	r = .118**, p = .000
CAS (total)	r = .278**, p = .000	r = -.049*, p = .014	r = -.075**, p = .000	r = .142**, p = .000	r = .160**, p = .000

CAS = Coronavirus Anxiety Scale; TELRA = Test of E-Learning Related Attitudes Scale. p < .05, ** p < .01

According to the correlation analysis, statistically significant but weak relationships were identified between COVID-19-related anxiety and attitudes toward e-learning (TELRA) (Table 8). While low-level positive and negative correlations were observed between CAS symptoms and the subdimensions of e-learning attitudes, a weak yet significant positive correlation was found between the overall CAS score, reflecting general anxiety, and the overall TELRA score, representing general e-learning attitudes. In particular, CAS scores were positively associated with tendency to use technology and perceived usefulness, whereas they were negatively associated with satisfaction and motivation. These findings suggest that COVID-19-related anxiety may increase orientation toward digital learning; however, such orientation does not necessarily align with emotional engagement or intrinsic motivation.

Discussion

The aim of this study was to examine the relationship between COVID-19-related anxiety and attitudes toward e-learning among sports sciences students. The findings revealed that approximately

one-quarter of the participants experienced anxiety above the cutoff level, with female students reporting higher anxiety symptoms than males. Regular exercise was associated with lower anxiety scores, although students who did not exercise tended to report more positive attitudes toward e-learning. In terms of e-learning attitudes, students with higher anxiety levels demonstrated greater tendencies toward technology use and perceived usefulness, whereas no substantial differences were observed in satisfaction and motivation. Correlation analyses confirmed weak but significant relationships, indicating that anxiety was positively linked to functional aspects of e-learning, yet negatively associated with emotional and motivational engagement.

In the context of e-learning practices that became widespread during the COVID-19 pandemic, the online delivery of practical courses in the field of sports sciences pedagogically complicated learning processes and directly influenced students' educational experiences [36, 37]. In this study, COVID-19-related anxiety was identified in 26.3% of sports sciences students (Table 2), a rate comparable to or lower than those reported in studies conducted

in other countries [22, 25, 38, 39, 40, 41, 42]. The findings indicate that anxiety exerts a limited effect on e-learning attitudes; however, students with anxiety showed significantly higher scores in technology use tendency, perceived usefulness, and overall TELRA scores (Table 5). Consistent with the literature, this can be explained by an increased drive to access information, maintain academic motivation, and view technology as a functional learning tool [21, 43]. Nevertheless, the relatively small differences in motivation and satisfaction suggest that technological orientation does not continuously support intrinsic motivation and may even reduce satisfaction levels, particularly in sports sciences courses that require motor-based learning [33, 44]. The tendency of anxious students to adopt digital solutions as a coping strategy [45] does not necessarily translate into improved learning outcomes. In fact, motivation and satisfaction levels were similar across groups, indicating that digital solutions were often used out of necessity rather than preference [46, 47]. Therefore, in times of crisis, the integration of virtual simulations, video-based interactive materials, and hybrid teaching models tailored to the needs of sports sciences, alongside counseling services that support students' psychological well-being, should be considered as strategic approaches to strengthen both cognitive and physical engagement in digital learning [14, 48].

Findings indicate that female students in the field of sports sciences reported higher levels of COVID-19-related anxiety and symptoms compared to male students (Table 3). Similar patterns have been reported in the literature, where female students were found to be psychologically more vulnerable during pandemic periods, displaying higher levels of anxiety and stress symptoms [18, 49, 50, 51]. This may be related to decreased academic motivation, heightened feelings of uncertainty, and intensified psychological symptoms. Moreover, women's greater sensitivity to health risks and increased susceptibility to pandemic-related news and warnings may have contributed to elevated anxiety [52]. The literature has also noted that this increase may be associated with the exacerbation of menstrual cramps [53]. The results further revealed that in both anxiety groups, female students considered e-learning technologies to be more accessible and useful, whereas male students consistently exhibited higher levels of motivation (Table 6). Comparable findings were also reported by Saddik et al. [25]. In this regard, female students' more positive attitudes toward technological systems may be linked to their adaptability to online education and a greater sense of responsibility [54], while the higher motivation observed in male students may be attributed to their interest in practice-based learning and expectations for face-to-face education [55]. Additionally, increased

anxiety levels may have fostered a more functional perception of digital systems, prompting greater reliance on these resources in the face of uncertainty. Nonetheless, the finding that satisfaction with e-learning remained low in both genders suggests that remote learning methods are inadequate for disciplines such as sports sciences, where practical courses constitute a substantial component.

Although the positive effects of regular exercise on physical, psychological, and mental health are well documented in the literature, its potential protective role during pandemics has also been a subject of inquiry. In the present study, students who maintained regular exercise during the pandemic exhibited lower levels of COVID-19-related anxiety and symptoms compared to those who discontinued or did not engage in exercise (Table 4). This finding suggests that physical activity may serve not only to sustain bodily health but also to support psychological well-being and emotional balance, thereby functioning as a protective factor against uncertainties. Previous research similarly reported that physical activity reduces anxiety and stress while enhancing mental health, findings consistent with the outcomes of this study [44, 56, 57, 58, 59]. The study further revealed that among both anxious and non-anxious students, those who did not engage in regular exercise reported significantly higher attitudes toward e-learning in the dimensions of tendency to use technology, satisfaction, motivation, and perceived usefulness. Moreover, in the anxious group, overall e-learning attitudes (TELRA) were also significantly higher among non-exercising students (Table 7). These results indicate that students who refrained from exercise during the pandemic were more inclined toward online learning systems and developed more positive attitudes toward them. Physical and social isolation during the pandemic, coupled with the interruption of campus life and restrictions on practical courses, led many students to abandon their exercise routines [44]. Given that the body serves as the primary medium of learning in sports sciences, the reduction in physical activity may have altered students' modes of learning interaction, increasing their sense of belonging to and reliance on digital environments [60]. The higher overall e-learning attitudes observed among non-exercising students may be explained by their perception of greater control in online environments, where they were distanced from the physical and social challenges of face-to-face education. In this context, e-learning may have provided them with a learning environment that was free from physical restrictions while being better aligned with their individual academic performance.

According to the correlation analysis results between CAS and TELRA, only weak relationships were identified (Table 8). In other words, as students' levels of COVID-19-related anxiety

increased, their attitudes toward using e-learning technologies and perceiving these systems as useful also rose significantly. Notably, increases in symptoms such as tonic immobility and sleep problems were associated with a greater inclination toward online learning. This finding suggests that students experiencing pandemic-related anxiety perceived e-learning systems used in distance education as safer and more controllable than participating in face-to-face educational activities [12]. Conversely, the weak and negative correlations observed for satisfaction and motivation indicate that although students considered online learning to be reliable and preferable, they did not necessarily regard the process as academically rich, effective, or fulfilling. In other words, the efficiency of embodied and physical learning environments in face-to-face education could not be fully replicated in distance education practices. Overall, these findings demonstrate that the e-learning experiences of sports sciences students during the SARS-CoV-2 pandemic were shaped not only by their technological competence but also by their psychological states and the structure and content of their curricula. Accordingly, in planning distance education activities during similar pandemic-related isolation periods or crisis situations such as natural disasters, attention should be given to students' psychological well-being, academic satisfaction, the diversity of pedagogical dimensions, and the practical components of courses.

Limitations

One of the main limitations of this study is that students from other disciplines with a high proportion of practical courses, such as visual arts, music education, and health sciences, were not included, despite their similarity to sports sciences in this regard. Another limitation concerns the data collection process, which relied on digital forms and may therefore involve biases such as subjective self-reporting errors. Additionally, as participants responded to the scales during a period of global crisis, the findings may not fully reflect tendencies under normal circumstances. Finally, the study did not track changes in students' academic achievement, which also constitutes a limitation.

Conclusions

This study revealed the multidimensional relationship between pandemic-related anxiety levels and attitudes toward e-learning among sports sciences students during the SARS-CoV-2 pandemic. The findings showed that 26.3% of students experienced pandemic-related anxiety, with female students reporting higher levels. The climate of uncertainty, social and physical isolation, and health concerns shaped not only students' mental health but also their attitudes toward e-learning

systems. Students with higher anxiety demonstrated more positive attitudes in terms of technology use, perceived usefulness, and overall orientation toward e-learning, whereas no similar increase was observed in satisfaction or motivation. Furthermore, students who maintained regular exercise reported lower levels of pandemic-related anxiety, while those who discontinued or did not engage in exercise displayed more positive attitudes toward e-learning. This indicates that physical activity and exercise contribute positively not only to physical health but also to psychological well-being, while students who refrained from exercise tended to rely more heavily on digital systems and developed a greater sense of belonging to e-learning environments.

In conclusion, the e-learning attitudes of students in sports sciences are shaped not only by their technological competencies but also by the psychological symptoms they experienced during the SARS-CoV-2 pandemic, as well as by gender, continuity of exercise, and the high proportion of practical courses inherent to the discipline. This highlights the need for pedagogical strategies in higher education during crises to be designed not solely around technical competence but also to support students' psychological resilience and academic satisfaction. The results emphasize the importance of integrating hybrid and flexible learning models into course designs for practice-oriented disciplines such as sports sciences, arts, and health sciences as part of crisis preparedness. In this context, for fields that inherently rely on practical education, supporting online content with tools such as virtual simulations, interactive videos, and augmented reality may enhance both learning continuity and student motivation.

Furthermore, three key recommendations can be proposed for instructors and educators in sports sciences:

- Course plans should be prepared in advance to include online adaptations of practical content for periods of crisis, such as pandemics or natural disasters.
- Counseling and psychological support mechanisms should be made accessible through digital platforms to safeguard students' mental health.
- E-learning systems should be continuously updated with user-friendly, accessible, and interactive technologies.

Therefore, future distance education policies to be implemented in extraordinary situations such as pandemics or natural disasters should be planned within a multidimensional framework that not only addresses technological infrastructure but also focuses on students' mental well-being, psychological resilience, and the pedagogical requirements of the discipline.

Acknowledgement

This study was prepared by abridging Üstün Türker's PhD thesis submitted to the Institute of Graduate Education, Department of Physical Training and Sports, Ondokuz Mayıs University. No

grants or financial support were received for this project.

Conflicts of interest

The authors declare no conflict of interest.

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Cite this article as:

Türker Ü, Bostancı Ö. The effect of SARS-CoV-2 pandemic on anxiety levels and attitudes towards e-learning among sports sciences students. *Physical Education of Students*, 2025;29(4):302-313. <https://doi.org/10.15561/20755279.2025.0407>

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Received: 24.07.2024

Accepted: 26.08.2025; Published: 30.08.2025