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E-Learning Readiness and Attitudes Among Medical Students After Emergency Remote Education: A Cross-Sectional Study

ABSTRACT

Background and Aims: Emergency remote education during the COVID-19 pandemic transformed medical education and exposed differences in students' capacity to learn online. This study assessed medical students' attitudes toward e-learning and e-learning readiness after this compulsory experience and examined whether readiness was associated with attitude independently of demographic characteristics and digital access.

Methods: This cross-sectional study included 656 students enrolled in years 1-5 at a medical school in Ankara, Türkiye. Attitudes were assessed with the 23-item Turkish Test of e-Learning Related Attitudes, and readiness with the 25-item Self-Assessment of Readiness for e-Learning scale. Associations were examined using Spearman correlation and multivariable linear regression.

Results: The participation rate was 26.2%. The mean item scores were 2.86 ± 0.53 for attitude and 3.98 ± 0.55 for readiness. Readiness was strongly and positively correlated with e-learning attitude (Spearman rho=0.607, 95% CI 0.432-0.749, p<0.001). The strongest domain correlations were observed for online skills (rho=0.626) and motivation (rho=0.592). In the multivariable model, a one-standard-deviation increase in readiness was associated with a 0.326-point increase in the mean attitude score (95% CI 0.223-0.429, p<0.001).

Conclusion: E-learning readiness, particularly online skills and motivation, was strongly associated with medical students' attitudes toward e-learning. Sustainable blended curricula should support online learning skills, motivation, and self-regulation in addition to providing infrastructure.

Keywords: Education, Distance, Educational Technology, Motivation, Curriculum, Computer Literacy

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Introduction

The COVID-19 pandemic required medical schools to move theoretical teaching, clinical skills instruction, and assessment to online environments within a very short period. This transition was emergency remote teaching rather than deliberately designed online education. Distinguishing these approaches is important because attributing all pandemic-related difficulties to the nature of online learning may obscure the influence of instructional design, faculty capability, and institutional support (1).

Online and blended learning can offer flexibility in time and place, repeated access to learning materials, self-paced study, and integration of digital resources. Evidence available before the pandemic indicated that well-designed online learning in undergraduate medical education was not inferior to face-to-face teaching for knowledge acquisition and selected skills. During the pandemic, however, studies of health sciences students reported variable satisfaction and outcomes, with unreliable internet access, insufficient student-teacher interaction, and social isolation among the most common barriers (2,3).

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Medical education requires the benefits and limitations of online learning to be considered together. Although digital environments can support theoretical knowledge and components of clinical reasoning, physical examination, procedural skills, multidisciplinary teamwork, and interaction with patients and role models require practice and immediate feedback. Medical students valued the flexibility and accessibility of online education during the pandemic but expressed concerns about clinical skills acquisition, limited interaction, and difficulty maintaining attention (4-8). Post-pandemic multicentre evidence suggests that students accept blended learning while continuing to regard direct patient contact as irreplaceable (9,10).

Sustainable adoption of e-learning depends on more than hardware and internet infrastructure. Technical competence, online communication, self-discipline, time management, and intrinsic motivation are central elements of readiness. Readiness may therefore shape attitudes toward e-learning and the future acceptance of blended models, together with access, self-efficacy, motivation, and instructional design (7,11-14).

The Technology Acceptance Model identifies perceived usefulness and perceived ease of use as major determinants of technology adoption (15). In parallel, self-determination theory emphasizes autonomy, competence, and relatedness as foundations of motivation in medical education (16,17), while self-regulated learning theory highlights goal setting, strategy selection, monitoring, feedback, and adaptation when learners control their time and learning behaviour (18). The Community of Inquiry framework further situates successful online learning at the intersection of cognitive, social, and teaching presence (19). Experiential and situated learning perspectives are particularly relevant to clinical education, in which authentic participation, observation, practice, and feedback remain essential (20-23).

Against this theoretical and empirical background, this study aimed to determine medical students' attitudes toward e-learning and their level of e-learning readiness after compulsory emergency remote education. It also examined the association between these constructs and whether the association persisted after accounting for demographic characteristics and digital access.

Materials and Methods

Study Design and Participants

This cross-sectional study was conducted at a public medical school in Ankara, Türkiye, between December 2025 and January 2026. No separate sampling procedure was used, all students enrolled in years 1-5 (N=2,500) were invited through their institutional email addresses to complete an online Google Forms survey. Reminder messages were sent once weekly for three weeks, and the form remained accessible for four weeks after the final message. A total of 656 students participated, corresponding to a participation rate of 26.2%.

The study was approved by the relevant institutional ethics commission (decision no. 2021-960). Participation was voluntary, and informed consent was obtained electronically before access to the survey.

Data Collection Instruments

The data collection form comprised three sections. The Sociodemographic and Digital Profile Form recorded age, programme language, year of study, sex, place of residence, perceived socioeconomic status, personal computer ownership, internet access, weekly internet use, and perceived digital competence.

Attitudes toward e-learning were measured using the Test of e-Learning Related Attitudes (TeLRA), originally developed as a 36-item instrument by Kisanga and Ireson (24). Primary scoring used the validated 23-item Turkish adaptation by Biçer and Korucu (25), which includes four domains: tendency to use technology, satisfaction, motivation, and usefulness. Items are scored from 1 to 4. Negatively worded items in the tendency to use technology and usefulness domains were reverse coded, higher scores indicate more positive attitudes.

E-learning readiness was assessed using the 25-item instrument developed by Watkins, Leigh, and Triner and adapted into Turkish by Kalelioglu and Baturay (13,14). It contains six domains: technology access, technical skills, online relationships, motivation, online skills, and importance to success. Items are scored from 1 to 5, with higher scores indicating greater readiness.

Statistical Analysis

Categorical variables were summarized as frequency and percentage, and continuous variables as mean, standard deviation, median, and interquartile range. Internal consistency was evaluated using Cronbach's alpha. The primary association between the mean total readiness score and mean total TeLRA score was examined using Spearman's rank correlation coefficient with 95% confidence intervals.

Two category group comparisons used the Mann-Whitney U test, and comparisons involving three or more categories used the Kruskal-Wallis test. A multivariable linear regression model used the mean total TeLRA score as the dependent variable and standardized total readiness score (per one standard deviation increase), sex, stage of education, and personal computer ownership as independent variables. Analyses were conducted using available observations in IBM SPSS Statistics for Windows 26.0 (IBM Corp., Armonk, NY, USA). All tests were two-sided, and $p<0.05$ was considered statistically significant.

Table 1. Mean item scores and internal consistency of the Test of e-Learning Related Attitudes and e-learning readiness scales and domains.

Scale/domain	Mean ± SD	Cronbach's alpha
TeLRA tendency to use technology	3.11 ± 0.58	0.783
TeLRA satisfaction	3.00 ± 0.65	0.744
TeLRA motivation	2.64 ± 0.70	0.873
TeLRA usefulness	2.73 ± 0.71	0.855
TeLRA total	2.86 ± 0.53	0.917
Readiness: technology access	4.05 ± 1.14	0.882
Readiness: technical skills	4.53 ± 0.59	0.719
Readiness: online relationships	4.02 ± 0.78	0.835
Readiness: motivation	3.36 ± 0.99	0.834
Readiness: online skills	3.88 ± 0.83	0.751
Readiness: importance to success	4.01 ± 0.64	0.779
Readiness total	3.98 ± 0.55	0.894

Note: SD = standard deviation; TeLRA = Test of e-Learning Related Attitudes.

Results

Participants had a mean age of 20.9 ± 2.0 years, 52.4% (n=343) were women and 61.0% (n=400) were in the preclinical stage. Most students were enrolled in the Turkish language programme (84.1%, n=552), owned a personal computer (87.8%, n=576), and had internet access (96.3%, n=632). A total of 78.0% (n=512) used the internet for at least nine hours per week, and 86.6% (n=568) rated themselves as competent or very competent in using digital tools.

The mean TeLRA item score was 2.86 ± 0.53, corresponding to a mean total score of 65.88 ± 12.30. The highest TeLRA domain mean was tendency to use technology (3.11 ± 0.58), and the lowest was motivation (2.64 ± 0.70). The mean readiness item score was 3.98 ± 0.55, corresponding to a mean total score of 99.48 ± 13.73. Technical skills had the highest readiness domain mean (4.53 ± 0.59), while motivation had the lowest (3.36 ± 0.99). Internal consistency was high for the total TeLRA and readiness scores (Cronbach's alpha=0.917 and 0.894, respectively) (Table 1).

Figure 1. Correlations between e-learning readiness domains and attitudes toward e-learning. Squares indicate Spearman's rank correlation coefficients, and horizontal lines indicate 95% confidence intervals. The dashed vertical line indicates no correlation.

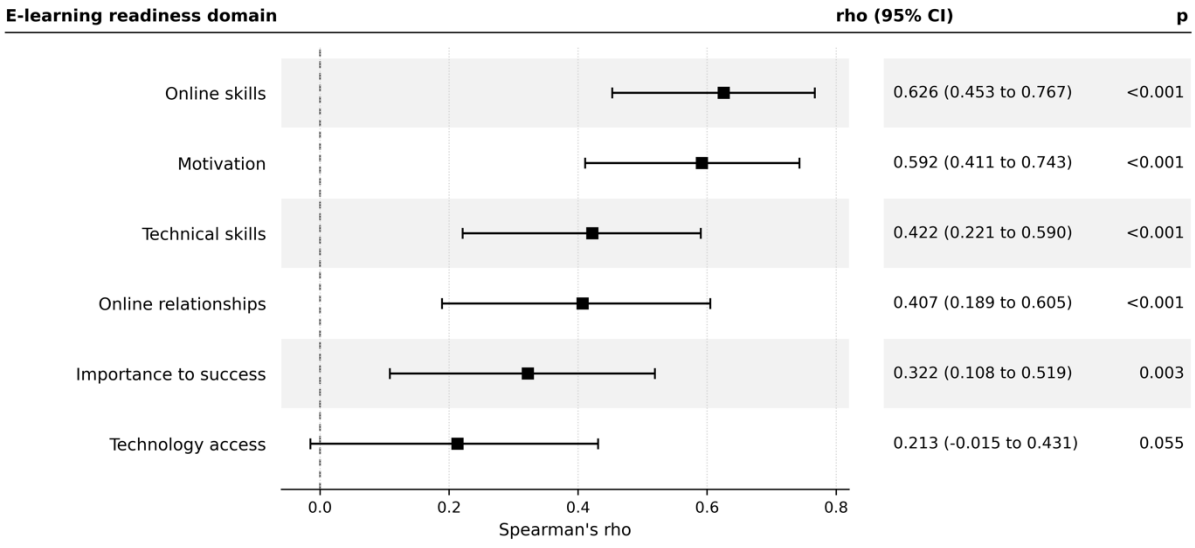


Table 2. Multivariable linear regression model of factors associated with attitudes toward e-learning.

Variable	B	SE	Standardized beta	95% CI	p
Readiness, per 1-SD increase	0.326	0.052	0.610	0.223 to 0.429	<0.001
Women (reference: men)	-0.068	0.102	-0.064	-0.271 to 0.135	0.507
Clinical stage (reference: preclinical)	0.069	0.098	0.063	-0.127 to 0.264	0.486
Personal computer ownership	-0.123	0.149	-0.076	-0.420 to 0.174	0.412

Note: The dependent variable was the mean total TeLRA item score. Readiness was standardized and modelled per one-standard-deviation increase. R^2=0.393; adjusted R^2=0.362. B = unstandardized coefficient; CI = confidence interval; SE = standard error.

Total readiness and total TeLRA scores were strongly and positively correlated (Spearman rho=0.607, 95% CI 0.432-0.749, p<0.001). The readiness domains most strongly correlated with attitude were online skills (rho=0.626, p<0.001) and motivation (rho=0.592, p<0.001). Technical skills, online relationships, and importance to success were also significantly correlated with attitude, whereas the correlation with technology access was weaker and did not reach statistical significance (p=0.055) (Figure 1).

Women had lower mean TeLRA scores than men (2.73 ± 0.52 vs 3.02 ± 0.51, p=0.006) and lower mean readiness scores (3.79 ± 0.57 vs 4.19 ± 0.44, p<0.001). Students who perceived themselves as competent or very competent in using digital tools had higher readiness scores than other students (4.04 ± 0.54 vs 3.56 ± 0.46, p=0.006). No statistically significant differences were found according to programme language, stage of education, place of residence, socioeconomic status, personal computer ownership, or weekly internet use.

The multivariable linear regression model explained 39.3% of the variance in the mean TeLRA score (R^2=0.393, adjusted R^2=0.362). A one standard deviation increase in readiness was associated with a 0.326 point increase in the mean TeLRA item score (95% CI 0.223-0.429, p<0.001). Sex, clinical stage education, and personal computer ownership were not independently associated with attitude in the model (Table 2).

Discussion

This study found high e-learning readiness and moderately favourable attitudes toward e-learning among medical students after compulsory emergency remote education. The principal finding was the strong positive association between readiness and attitude, which remained after adjustment for sex, educational stage, and personal computer ownership. Online skills and motivation showed the strongest domain-level correlations, suggesting that attitudes depend less on device ownership alone than on students' capacity to sustain learning in digital environments.

Students with stronger technical and online skills may perceive digital environments as easier to manage and less effortful. This perception can strengthen perceived ease of use, perceived usefulness, and general acceptance, consistent with the Technology Acceptance Model (15). The high internal consistency of the TeLRA usefulness and tendency-to-use-technology domains supports the coherence of these constructs in the present sample.

Technology access was only weakly associated with attitude. This may reflect the high prevalence of internet access (96%) and personal computer ownership (88%), which limited variability in access. Access remains a prerequisite rather than an unimportant factor, however, once access is widespread, differences between learners may increasingly reflect skills, support, and instructional design. In resource constrained settings, connectivity and cost remain major barriers (7,9).

Online learning can support autonomy by allowing greater choice of place, time, and pace. However, when it is reduced to the transmission of materials, social connection, feedback, and perceived competence may weaken. Successful completion of digital tasks can support competence, while meaningful interaction with peers and teachers can support relatedness. The strong association between readiness-related motivation and attitude in this study is therefore consistent with self-determination theory and with evidence that motivation is both a determinant and an outcome of the educational environment (16,17).

Online environments also require learners to set goals, regulate attention, select appropriate resources, monitor progress, and seek help when needed. Skills such as taking notes from video, processing information in different formats, and maintaining online interaction can facilitate these self-regulatory processes (18). Conversely, limited online skill may redirect cognitive resources from learning content to platform navigation and task management, with repeated failure weakening self-efficacy and attitude.

Low interaction and distraction were frequently reported during the pandemic, and students in post-pandemic studies continue to request more interactive online sessions (3,4,9,19). Readiness should therefore be understood as an alignment between learner skills, instructional design, and institutional support rather than as an individual trait alone. Technical assistance, accessible materials, predictable course structures, regular teacher communication, peer interaction, and low-stakes formative assessment can help students translate existing skills into learning.

A related study from the same institution, conducted during the pandemic with 635 students and 107 faculty members, reported moderate student readiness and comparatively low motivation, together with reservations about the effectiveness of distance education (26). The present post-emergency study extends that work by focusing exclusively on students, using different measures of attitude and readiness, examining domain-level correlations, and estimating the adjusted association between the two constructs.

The observed sex differences should not be interpreted as fixed biological characteristics. They may reflect differences in digital experience, perceived competence, learning opportunities, or social expectations. Students who rated their digital competence more positively also had higher readiness, although perceived competence is not equivalent to observed performance. Future studies should combine self-report measures with learning-platform data, task completion indicators, or performance-based digital skills assessments.

For curriculum development, the findings argue against limiting intervention to devices and connectivity. Blended learning should follow constructive alignment: asynchronous modules may support preparation, knowledge acquisition, and review, synchronous case discussion and virtual patients may support clinical reasoning and communication, and face-to-face simulation and workplace learning should remain central for physical examination and procedural skills (20-23). Assessment should also match the intended competency: online knowledge tests should not substitute for direct observation and structured performance assessment when practical competence is the target.

Study Limitations

The study has several limitations. It was conducted at a single institution and used a cross-sectional design. The participation rate was 26.2%, creating potential non-response bias and limiting generalizability. Measures were self reported, and actual platform use, academic achievement, and clinical performance were not evaluated. The high prevalence of computer and internet access may have produced a ceiling effect in the access domain. Finally, the cross-sectional design does not permit causal conclusions about whether readiness shapes attitude or positive attitude encourages students to develop online learning skills.

Conclusion

E-learning readiness was strongly associated with favourable attitudes toward e-learning among medical students, with online skills and motivation showing the strongest relationships. Technology access had more limited explanatory value in this highly connected sample. Sustainable digital education in medical schools should therefore combine infrastructure with blended curriculum design that supports learner competence, motivation, self-regulation, faculty readiness, and the experiential nature of clinical learning.

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Conflict of Interest

The authors declare no conflicts of interest.

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