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Examining the relationship between teacher candidates' techno-stress levels and information and communication technologies competencies

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ABSTRACT

This study was conducted using a quantitative correlational survey model to determine pre-service teachers' levels of technostress and their information and communication technology (ICT) competencies and to examine them according to various variables. Data were collected from 427 pre-service teachers in their third and fourth years from nine programs at the Faculty of Education, Akdeniz University, in 2024–2025. Measurements were made using the Teacher Technostress Level Determination Scale and the ICT Competence Scale; following descriptive statistics and normality checks, Spearman correlation, Mann–Whitney U, and Kruskal–Wallis H tests were applied. The findings showed that ICT competencies were low, technostress was high, and there was a negative, significant relationship between the two variables. Only in instructional design did males score higher. Technostress was higher and digital competency was lower in the Science Education and Guidance programs. The use of technological tools and mobile devices has been linked to higher ICT competencies and lower levels of technostress. The findings suggest that enhancing digital competencies may be a critical factor in alleviating technostress.

Keywords: teacher candidates, technostress, stress, information and communication technologies

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INTRODUCTION

Today, the education system is undergoing a profound transformation process due to the impact of digitalization. Especially after the COVID-19 pandemic, the widespread adoption of distance education has further increased teachers' need for information and communication technologies (ICT). This transformation necessitates that teacher candidates develop their competencies in digital tools and be able to use these tools effectively. However, the rapid development of technology and its intensive use in educational environments have also brought some negative effects. One of the prominent concepts among these negativities is "technostress."

The term technostress was first introduced by Brod (1984) to describe the stress situations individuals experience in coping with technology. Brod described technostress as a contemporary adjustment disorder that arises from an individual's inability to adapt healthily to new computer technologies. Today, technostress has become a significant source of stress, especially in work and educational environments where information and communication technologies (ICT) are widely used (Tarafdar et al., 2007). Although ICT has the potential to facilitate individuals' lives, the stress factors caused by these technologies should not be overlooked. Especially in digitalized educational environments, the ability of teacher candidates to cope with technological stress is critically important both individually and professionally. Studies have shown that technostress increases teachers' feelings of burnout, decreases job satisfaction, and negatively affects their professional performance (Aktan & Toraman, 2022; Cahapay & Bangoc, 2021; Malaquias & De Souza Júnior, 2023).

The widespread adoption of online teaching following the COVID-19 pandemic has led to an increase in teachers' workload, blurred boundaries between professional roles and family life, and made technology-related health issues more visible (Marrinhas et al., 2023). Factors such as infrastructure deficiencies brought about by the mandatory online teaching process, inadequate technical support, lack of digital skills, and the necessity for rapid adaptation have led to various psychological issues in teachers, such as anxiety, mental exhaustion, and decreased motivation (Panisoara et al., 2020; Bordi & Nuutinen, 2023; Estrada-Muñoz et al., 2021). Such stressors reduce teachers' motivation to use ICT, which in turn can negatively affect the quality of their teaching-learning processes and indirectly impact student success (Aktan & Toraman, 2022; Estrada-Muñoz et al., 2021; Bordi & Nuutinen, 2023). Therefore, in addition to teacher candidates' access to digital technologies, developing their skills to cope with the stress created by these technologies has become a fundamental requirement for adapting to digitalized educational environments.

It appears that various factors play a role in the experience of technostress among teachers and teacher candidates. Low perception of digital competence, technological complexity, and uncertainty are factors that lead to psychological distress in individuals (Ragu-Nathan et al., 2008). The increased mandatory use of technology during the pandemic has raised levels of technostress among teachers; this increase has been found to be associated with work-family conflict and technology-related health issues (Wang et al., 2023). Frequent changes and updates of digital tools can create pressure for competence through 'techno-uncertainty/complexity' (Tarafdar et al., 2007). This pressure has also been reported in relation to the intention and motivation to continue online teaching (Panisoara et al., 2020). The increasing technological demands after the pandemic have raised technostress among teachers and may have negatively affected their intention to adopt remote teaching technologies. Additionally, perceived organizational/technical support has negatively affected technostress (Gabbiadini, Paganin & Simbula, 2023). The systematic reviews during the COVID-19 period have shown that in-service teachers have faced difficulties in coping with technological demands and increased stress responses; these findings indicate that similar pressures may pose risks for teacher candidates as well (Nang, Maat & Mahmud, 2022).

Despite frequently being exposed to digital tools, teacher candidates feel inadequate regarding pedagogical integration, which can increase their levels of technostress. For example, McGarr and McDonagh (2020) emphasize that although teacher candidates actively use digital tools in daily life, they do not feel sufficiently competent in educational contexts, which causes anxiety. Similarly, Harakchiyska (2023) has revealed that teacher candidates' individual perceptions of their digital competency levels can contradict their actual skills, leading to difficulties in the digital integration process.

Understanding the psychological challenges faced by teacher candidates when using technological tools is important for supporting their adaptation to the digital transformation process. In this regard, determining levels of technostress can help identify the problems that teacher candidates face during their interactions with technology and the underlying causes of these problems. Indeed, there are structural equation models and qualitative findings indicating that TPACK and computer self-efficacy negatively predict technostress among teachers (Dong et al., 2020; Khlaif et al., 2022). Additionally, it has been shown that self-efficacy in teacher candidates is related to TPACK/WPCK competencies, and this relationship may increase teacher candidates' readiness for technology integration while indirectly supporting their ability to cope with stress (Feng & Xia, 2023; Bağcı & Atar, 2019). However, it is also stated that technological stress can negatively affect the alignment with individual productivity and role expectations (Tarafdar et al., 2007). Therefore, the relationship that teacher candidates establish with technology should be addressed not only at the level of access but also in the context of understanding the stress and difficulties created by this process. This situation is important in terms of both enhancing their digital adaptation and professional competencies.

Therefore, the aim of the present study is to examine the relationship between the levels of technostress of teacher candidates and their information and communication technology competencies in terms of various variables. It is thought that the results of this study will guide

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institutions that train teachers and contribute to the development of digital competency-based support practices for teacher candidates. Additionally, the study is expected to reveal the areas where development is needed to reduce technostress. Thus, it may be possible to structure the processes related to teacher education in a more holistic and effective manner.

METHOD

This research was conducted to examine the relationship between the information and communication technology competencies of teacher candidates and their levels of technostress, and to determine the differences according to demographic variables. The study was based on relational and descriptive survey designs within the scope of quantitative research methods. Relational scanning reveals the co-variation situation between two variables while descriptive scanning aims to determine the current situation and the characteristics of the groups (Şen & Yıldırım, 2021).

The study group of the research consisted of 3rd and 4th grade teacher candidates studying at the faculty of education. A total of 427 teacher candidates participated in the research. 65.1% of the participants (n=278) were female, and 34.9% (n=149) were male. Regarding the distribution by department, the highest rates were in Guidance and Psychological Counseling (PDR) (%15, n=64) and Special Education (%13.3, n=57); followed by science (%12.4, n=53), Preschool (%11.2, n=48), and elementary mathematics (%10.8, n=46). Social Studies (%10.5, n=45), Classroom (%9.8, n=42), English (%9.1, n=39) and Turkish (%7.7, n=33) departments were also included in the study group.

Participants were selected using criterion sampling, a purposive approach. Ethical approval was obtained from the relevant institutional ethics committee. Participation was voluntary, with informed consent gathered before accessing the survey. The study's target population included teacher candidates enrolled in education faculty programs. The inclusion criterion was being a teacher candidate enrolled in one of the relevant undergraduate teaching programs at the time of data collection. Data were collected from 427 teacher candidates who met this criterion and agreed to participate. Since all reached and consented candidates completed the survey, the response rate was 100%.

The Personal Information Form includes items related to participants' gender, class level, daily internet usage time, social media usage time, time spent on online games, technology tools used, and the level of usage of technological tools.

The Teachers' Technostress Levels Defining Scale (TTLDS) was developed by Çoklar et al. (2017). In the scale development process, a draft form consisting of 51 items was initially prepared and reduced to 48 items based on expert opinions. Subsequently, exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were conducted on the data obtained from 395 teachers, determining that the scale consisted of 28 items and five factors (learning-teaching process-focused, profession-focused, technical-problem focused, personal-focused, and social-focused). The scale was rated on a five-point Likert scale (1=Strongly Disagree, 5=Strongly Agree), with a Cronbach's alpha internal consistency coefficient of .917 and a Spearman-Brown reliability coefficient of .845. These findings indicate that the scale is a valid and reliable measurement tool (Çoklar et al., 2017).

Since the scale was developed for teachers and some items included teacher-oriented expressions, the items were revised in line with the opinions of two social studies field experts, one language expert, and one psychometrician. Since some wording changes were made in the items, the process was considered within the scope of an adaptation study, and confirmatory factor analysis was conducted to examine the construct validity of the scale. When the fit indices obtained from the first-order confirmatory factor analysis were examined, the model was found to show an acceptable/good fit with the data (CFI = .910, RMSEA = .043, 90% CI [.038, .049], SRMR = .047, χ^2 (340) = 613.573, $p < .001$). The standardized factor loadings for the model ranged from .325 to .742, and all factor loadings were statistically significant ($p < .001$). The average variance extracted values were calculated as .301 for the learning process-focused factor, .331 for the profession-oriented factor, .248 for the technical subject-focused factor, .412 for the

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personal-focused factor, and .391 for the social-focused factor. When the reliability coefficients were examined, Cronbach's alpha coefficients ranged from .663 to .772 for the factors and were .899 for the overall scale; omega coefficients ranged from .637 to .772 for the factors and were .906 for the overall scale. The relationships among the factors ranged from .504 to .866, and all were found to be statistically significant, which made it necessary to examine a more general structure explaining the five factors. Accordingly, the second-order confirmatory factor analysis showed that the model had an acceptable fit with the data (CFI = .888, RMSEA = .048, 90% CI [.043, .053], SRMR = .053, $\chi^2(345) = 686.122$, $p < .001$). The standardized factor loadings for the second-order model ranged from .750 to .917, and all loadings were significant ($p < .001$). Omega coefficients were calculated as ranging from .663 to .773 for the sub-factors, .908 for the overall scale, and .840 for the second-order general factor. The findings indicate that the five-factor structure of the scale was supported, that factor scores can be used separately, and that a total score can also be obtained from the scale due to the presence of a general technostress structure explaining the factors.

Information and Communication Technologies Competencies Scale for Teacher Candidates. The scale was developed by Tondeur et al. (2017) and later adapted to Turkish culture by Alkan and Emmioğlu-Sarıkaya (2018). Consisting of 19 items, the scale was rated on a 5-point Likert scale (1=Strongly Disagree, 5=Strongly Agree) and has a two-factor structure: (1) competencies aimed at supporting students' ICT usage and (2) ICT competencies related to instructional design. In the original study, the construct validity of the scale was tested through exploratory and confirmatory factor analyses, and it was found that the two-factor structure was valid and explained 56.3% of the total variance. In the Turkish adaptation study, the findings of confirmatory factor analysis also confirmed the original structure of the scale, and as a result of convergent, discriminant, and concurrent validity analyses, it was determined that the scale was a valid measurement tool. The Cronbach alpha internal consistency coefficients of the scale were calculated as .94 for the first factor and .89 for the second factor, showing a high level of reliability (Alkan & Emmioğlu-Sarıkaya, 2018; Tondeur et al., 2017).

The assumption of normality and the analysis process were conducted through R (2023), Jamovi (2023), JASP (2024), and SPSS software packages. The assumption of normality was examined with skewness, kurtosis values, and the Shapiro-Wilk test, and the results indicated that the scale scores were not normally distributed ($p < .05$). Therefore, the Mann-Whitney U Test was used for group comparisons in the demographic variables with two groups. Effect size was calculated using the paired serial correlation coefficient and was rated as small at .10, medium at .30, and large at .50 (Kerby, 2014). For comparisons of more than two groups, the analyses were conducted using the Kruskal-Wallis H Test, which is the nonparametric alternative to One-Way ANOVA. To determine the effect size, Epsilon squared (ε^2) was calculated, and .10 indicates a small effect, .25 a medium effect, and .37 a large effect (Büyüköztürk et al., 2018).

Before proceeding with the analyses, the distribution pattern of missing values in the data set was examined. For this purpose, Little's MCAR test was applied using the "MCARtest" package in R (Berrett et al., 2025). The analysis revealed that the missing values did not show a systematic pattern and were randomly distributed. Accordingly, the mean imputation method was used to address the missing data. Subsequently, the multivariate normality assumption was evaluated using Mardia's test via the "MVN" package in R (Korkmaz et al., 2014). Considering that the items on the scale are categorical, importance was placed on selecting an appropriate estimation method for confirmatory factor analysis. Koğar and Yılmaz Koğar (2016) indicate that the Diagonal Weighted Least Squares method provides more accurate estimates with lower error in confirmatory factor analyses conducted with categorical data sets. Therefore, the DWLS estimation method was preferred in the analysis. Additionally, to assess the assumption of multicollinearity, correlations between items were examined, and based on the findings, it was concluded that there was no multicollinearity issue in the data set.

Before conducting the regression analysis, the distributions of the variables were examined, and some variables were found to deviate from normality. However, according to Tabachnick and Fidell (2012), the normality assumption in regression analysis pertains not to the raw scores of the dependent or independent variables, but rather to the normal distribution of the error

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terms/residuals derived from the model. Therefore, during the analysis, rather than focusing solely on the individual distributions of the variables, the regression model residuals and influential observation measures were evaluated. When the findings were examined, the meaning of the residuals was very close to zero (M = .000). This finding is consistent with the assumption that the expected value of the error term is zero. The standardised residuals ranged from -6.998 to 2.737, indicating that some observations have extreme residuals, particularly in the negative direction. However, Cook's distance values ranged from .000 to .328 and remained below 1, suggesting that these observations do not exert an excessively high influence on the regression model (Fox, 2002). Similarly, the leverage values were low (Centered Leverage Value = .000–.037). The highest Mahalanobis distance was 15.958, suggesting that some observations are relatively distant from the centre in terms of the predictor variables; however, when considering Cook's distance and leverage values together, these observations do not significantly distort the model results. In this context, despite deviations from normality in the raw scores of the dependent and independent variables, the fundamental assumptions of regression analysis were evaluated using residuals and measures of influential observations, and the analyses were deemed applicable.

FINDINGS AND DISCUSSION

Findings

Total scores from the teachers candidates' technostress level and information and communication technologies competency level scales

Table 1 shows that cut-off scores was determined for both the Technostress Level Determination Scale and the Information and Communication Technology (ICT) Competency Scale on an item basis. According to the five-point Likert scale, technostress levels were classified as 28.00–65.33 low, 65.34–102.66 medium, and 102.67–140.00 high, and the average score obtained from the scale ($\bar{X}$ = 110.84) indicated that the group had a high level of technostress.

Table 1. Teacher candidates' levels of technostress and information and communication technology competence levels scale scores

Variable	Low	Medium	High
Technostress Level	28,00-65,33	65,34-102,66	102,67-140,00
Information and Communication Technologies Competency Level	19,00-44,33	44,34-69,67	69,68-95,00

Similarly, the cut-off scores for ICT competencies were determined as 19.00–44.33 low, 44.34–69.67 medium, and 69.68–95.00 high, and the average score ($\bar{X}$ = 42.92) revealed that the group had a low level of ICT competency.

Analysis of the relationship between teachers candidate' levels of technostress and their scores on information and communication technology competency scales

When Table 2 is examined, it is seen that the information communication technology score was a significant predictor of the techno stress score (R^2=.365, p<.05). In other words, 36.5% of the total variance regarding the techno stress score was explained by the information communication technology score.

Table 2. Findings related to simple linear regression analysis for predicting teacher candidates' technostress levels

Variable	B	Constant Error B	β	t	p
Constant	146.025	2.305		63.357	.001
Information Communication Technology Level	-.820	.052	-.604	-15.618	.001

Note: R = .604, R^2 =.365; F(1.425) = 243.911 p =.001; 146.025-.820xInformation Communication Technology Level=Techno Stress Level

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In a simple linear regression analysis, the level of information and communication technology proficiency significantly predicted the technostress levels of prospective teachers, $F(1, 425) = 243.911$, $p < .001$. The correlation coefficient related to the model was calculated as $R = .604$, and the explained variance ratio as $R^2 = .365$. This finding indicates that 36.5% of the total variance in prospective teachers' technostress levels is explained by their level of information and communication technology proficiency. When examining the regression coefficients, the unstandardised coefficient for the level of information and communication technology proficiency was negative ($B = -.820$, $\beta = -.604$, $t = -15.618$, $p < .001$). Accordingly, a one-unit increase in information and communication technology proficiency is associated with a decrease of 0.820 units in technostress levels. The negative coefficient obtained demonstrates that as information and communication technology proficiency increases, technostress levels decrease.

Teacher candidates' technostress level and information and communication technologies competence level scores according to demographic variables

Table 3. Mann-Whitney u test regarding scale scores of teachers candidates' technostress level and information and communication technology competence level according to gender variable

Scale	Variable	Gender	N	Mean Rank	Sum of Ranks	U	z	p	Double Serial Correlation [%95CI]
Teacher Candidates' Techno-Stress Level	Total Technostress Score	F	278	233.06	64791.50	15.411.500	4.363	.001	.256 [.143, .369]
		M	149	178.43	26586.50				
	Learning Process-focused	F	278	227.52	63249.50	16.953.500	3.115	.002	.181 [.067, .296]
		M	149	188.78	28128.50				
	Career-focused	F	278	233.68	64963.50	15.239.500	-4.528	.001	.264 [.151, .377]
		M	149	177.28	26414.50				
	Technical Subject-focused	F	278	228.88	63630.00	16.573.000	3.434	.001	.200 [.085, .314]
		M	149	186.23	27748.00				
	Personal-focused	F	278	227.28	63184.00	17.019.000	-3.075	.002	.178 [.063, .293]
		M	149	189.22	28194.00				
	Social-focused	F	278	222.74	61923.00	18.280.000	-2.030	.042	.117 [.002, .233]
		M	149	197.68	29455.00				
Information and Communication Technologies Competency Level	Total Score of Information Communication Technologies	F	278	206.36	57368.50	18.587.500	-1.748	.080	
		M	149	228.25	34009.50				
	ICT Competencies Supporting ICT Uses	F	278	205.84	57222.50	18.441.500	1.871	.061	
		M	149	229.23	34155.50				
	ICT Competencies for Instructional Design	F	278	204.42	56829.00	18.048.000	-2.198	.028	.129 [.013, .244]
		M	149	231.87	34549.00				

Note: F = Female, M = Male; N = sample size; U = Mann–Whitney U; z = standardized test statistic (reported as an absolute value; direction is indicated by the mean ranks); CI = confidence interval. The effect size is the rank-biserial correlation

When Table 3 is examined, a significant difference was found in the average ranks of total technostress scores according to the gender variable (U=15411.500, p=.001), and the average rank

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of females (233.06) was significantly higher than that of males (178.43). When the sub-dimensions are examined, although the average rank of females in learning process-focused scores (227.52) was higher than that of males (188.78), it was found that the difference was significant (U=16953.500, p=.002) and the effect size was small. Similarly, in the dimensions of career-focused (U=15239.500, p=.001), technical subject-focused (U=16573.000, p=.001), personal-focused (U=17019.000, p=.002), and social-focused (U=18280.000, p=.042), the average ranks of females were significantly higher than those of males and the effect size in all these differences was small.

When Table 4 is examined (See Appendix 1), significant differences were found in the total technostress score averages according to the department variable, with respect to the sub-dimensions of learning process focused, profession-focused, technical subject focused, personal-focused, and social focused scores (p = .001). The results of the Dwass-Steel-Critchlow-Fligner pairwise comparison tests conducted to determine which groups the differences existed between are presented in the table, and it was observed that the effect size was small in all these dimensions.

Significant differences were also found in the total score of information and communication technologies and the scores of ICT competencies for supporting ICT uses and for instructional design (p = .001). The effect sizes regarding these differences were found to be medium.

When Table 5 is examined (See Appendix 1), a significant difference was found between the average rank scores of the total technostress score according to the daily internet usage variable (χ^2=11.919, p=.003). According to the results of the Dwass-Steel-Critchlow-Fligner test, the average score of the group using the internet for more than 6 hours was lower than that of the group using it for 0-3 hours, and the effect size of this difference was small. When the results are examined in sub-dimensions, it was similarly observed that the average score of the group using more than 6 hours was lower than that of the 0-3 hours group in career-focused (χ^2=13.097, p=.001) and personal-focused (χ^2=9.494, p=.022) scores, and the effect size remained small. In contrast, no significant differences were found in the dimensions of learning process-focused (χ^2=5.929, p=.052), technical subject-focused (χ^2=2.348, p=.309), and social-focused (χ^2=2.524, p=.283).

Additionally, no significant differences were observed between the groups in terms of total ICT score (χ^2=.087, p=.957), competencies supporting ICT usage (χ^2=.575, p=.750), and ICT competencies related to instructional design (χ^2=.019, p=.991).

Table 6 (See Appendix 1) indicates that there were significant differences in total technostress scores and sub-dimensions (learning process-focused, career-focused, technical subject-focused, personal-focused, and social-focused) according to the level of technological tool use (p = .001). According to the results of the Dwass-Steel-Critchlow-Fligner test, the average scores of the group using tools at a poor level were lower than those of the medium and good groups; the scores of the medium level group were higher than those of the good group. It was also found that the effect size in all these differences was small.

Similarly, significant differences were found in the total score of information and communication technologies and in ICT competencies for supporting ICT uses and instructional design (p = .001). Here, the scores of those using tools at a poor level were lower than those of the medium and good groups, while the scores of the medium level group were lower than those of the good group. These findings indicate that as the level of technological tool usage increased, both technostress and ICT competencies differed more positively, but the effect size remained small.

Discussion

The findings obtained within the scope of this research revealed a significant and inverse relationship between teacher candidates' levels of Information and Communication Technologies (ICT) competence and their levels of technostress, with a moderate negative correlation indicating that higher ICT competence is associated with lower technostress. This pattern is well supported in literature. Saltan and Bozbey (2024) found that as classroom teachers' ICT competencies increased, their technostress levels decreased significantly. Syvänen et al. (2016) similarly

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identified ICT competence as one of the strongest determinants of technostress among teachers in Finland. Wang and Li (2019) further demonstrated that low ICT competence negatively affects job performance and constitutes a significant source of stress among university faculty. Galorport and Estela (2022), through structural equation modeling, confirmed that teachers' TPACK and ICT skills are key factors shaping technostress, with lower digital competence associated with higher stress. Çalışkan and Çoklar (2022) and Çetin (2017) reached parallel conclusions with teacher candidate samples, finding that higher ICT self-efficacy is associated with fewer difficulties in technology-related tasks.

Gökbulut (2021) found a negative but low-level relationship between technopedagogical competencies and technostress among in-service teachers. The stronger, medium-level relationship observed in the present study may reflect the particular vulnerability of teacher candidates at the beginning of their professional development, who may be more likely to perceive technological inadequacy as a source of stress. Akay and İncik (2017) noted that as technopedagogical competence increases among teacher candidates, their attitudes towards technology develop more positively, potentially reducing stress. Tondeur et al. (2017) similarly showed that courses targeting digital pedagogical skills increase confidence in technology integration, which may in turn contribute to lower technology-related stress. Al-Fudail and Mellar (2008) further argued that teacher-technology-environment interactions shape how stress is experienced, with technological skill and perceived support serving as key moderating factors. Atanasoff and Venable (2017) similarly emphasized that the lack of technological competence and the pressure to adapt to technology are major factors associated with stress among employees. Taking together, these findings suggest that professional development for teacher candidates should address not only technical skills but also pedagogical approaches and psychological resilience.

The findings regarding the gender variable are largely consistent with literature. In the study, the levels of technostress among female teacher candidates were found to be significantly higher compared to males. This situation is compatible with the view emphasized by Broos (2005) that female teacher candidates experience lower confidence and more shyness in technology use. However, in the research conducted by Alastor, Guillén-Gámez, and Ruiz-Palmero (2025) with teacher candidates, it was revealed that gender does not create a significant difference in digital competencies. Additionally, Çalışkan and Çoklar (2022) also found that gender does not create a significant difference in technostress levels. These results, which contradict the research findings, may stem from differences in the sample group, cultural context, or measurement tools.

The findings regarding inter-departmental differences show that teacher candidates significantly differed in digital competence and technostress levels according to the types of programs. Suárez-Rodríguez, Almerich, Orellana, and Díaz-García (2018) revealed that not only individual characteristics, but also contextual and program-based factors are decisive in teachers' levels of ICT competence. Wang and Li (2019) further demonstrated that dimensions of technostress such as techno-insecurity and techno-complexity are directly related to teaching performance and ICT attitudes, which may help explain the elevated technostress observed in Science and GPC programs in the present study. These findings collectively suggest that the field and structure of the program play a decisive role in shaping teacher candidates' digital pedagogical competencies and technostress levels.

The use of mobile devices stands out as a variable associated with meaningful differences in both technostress and ICT competence levels of teacher candidates. Galustyan et al. (2019) found that mobile technologies play a critical role in the development of media and digital competences of teacher candidates, particularly when integrated with pedagogical skills. Tonbuloglu and Kiyici (2018) linked acceptance of mobile technologies for teaching purposes to individual competence perceptions, while Dai (2023) showed that mobile device integration and ICT self-efficacy levels significantly predict digital competence and may be associated with lower stress factors. These results suggest that frequent engagement with mobile devices may strengthen teacher candidates' capacity to cope with technological stress.

Overall, the findings point to the need for a holistic approach in preparing teacher candidates for the digital age, with digital pedagogical competence placed at the center of teacher

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training programs. In this context, not only technical skills but also elements such as psychological resilience, developing a positive attitude, and access to social support mechanisms should be fostered in teacher candidates' technological adaptation processes. Basarmak, Hamutoğlu, and Şahin (2020) demonstrated that barriers to technology integration shape lifelong learning tendencies among teacher candidates. Tondeur et al. (2019) emphasized that experiences and role models related to technology integration in teacher training programs play a critical role in developing digital pedagogical competences. König, Jäger-Biela, and Glutsch (2020) further highlighted that teachers' adaptation to online teaching during COVID-19 was closely tied to digital competence and pedagogical flexibility. These results reinforce the need to restructure teacher training programs to meet the requirements of the digital age.

CONCLUSION

This study examined the relationship between the technostress levels of teacher candidates and their information and communication technologies (ICT) competency levels. The results indicate that teacher candidates have high levels of technology-related stress and low ICT competencies, with a significant inverse and moderate relationship between the two constructs. Correlation analyses confirmed that as ICT competency scores increased, technostress scores decreased across most sub-dimensions, particularly in learning process-focused, profession-focused, technical subject-focused, and personal-focused stress dimensions. Simple linear regression analysis further supports this pattern: ICT competence is a significant predictor of technostress, explaining approximately 36% of its total variance. In other words, teacher candidates who feel more competent in using digital technologies are less likely to experience technology-induced stress, and each increase in ICT competence is associated with a statistically significant decrease in technostress levels.

Analyses by demographic variables revealed several notable patterns. Female teacher candidates reported significantly higher technostress than males across all sub-dimensions, though effect sizes were small, and no significant gender difference was found in overall ICT competence. Departmental comparisons showed that candidates in GPC, Science, and Preschool Teaching programs had higher technostress and lower ICT competence, while those in Turkish and Social Studies Teaching had more favorable profiles, suggesting that curricular content and levels of technological integration shape these outcomes. Regarding technology use, candidates who rated their use of technological tools more highly showed both lower technostress and higher ICT competence in a consistent, graduated pattern; similarly, mobile device and tablet users reported lower technostress levels, with mobile phone users also demonstrating higher ICT competence. Taken together, these findings indicate digital pedagogical competencies, encompassing both technical training and increased hands-on engagement with technology, are significantly associated with lower technostress levels in teacher education programs.

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Appendix 1.

Table 4. Kruskal-Wallis h test regarding the scores of teacher candidates' technostress level and information and communication technology competence level according to department variable

Scale	Variable	Department	N	Mean Rank	Mean	SD	X^2	df	p	ε^2 [%95 CI]	Difference
Teacher Candidates' Technostress Level	Total Technostress Score	Social Studies (1)	45	161.10	107.0	13.08	111.4	8	.001	.262 [.243, .281]	1>2,1<3,1<4
		Turkish (2)	33	65.56	92.2	17.17					1<5,2<3,2<4,
		Science (3)	53	287.41	114.6	13.74					2<5,2<6,2<7
		Preschool (4)	48	233.24	114.4	5.88					2<8,2<9,3>6
		GPC (5)	64	296.29	116.2	11.55					3>7,3>8,3>9
		English (6)	39	211.33	113.0	4.99					4<5,5>6,5>7
		Special Education (7)	57	207.39	112.8	5.55					5>8,5>9
		Elementary Mathematics (8)	46	208.02	111.0	11.26					
		Classroom (9)	42	165.30	107.8	12.46					
	Learning Process-focused	Social Studies (1)	45	133.97	25.8	3.99	69.3	8	.001	.163 [.144, .182]	1<3,1<4,1<5
		Turkish (2)	33	94.70	24.0	4.94					1<6,1<7,1<8
		Science (3)	53	236.34	28.5	3.12					2<3,2<4,2<5
		Preschool (4)	48	277.73	29.6	2.00					2<6,2<7,2<8
		GPC (5)	64	236.05	28.5	3.19					2<9
		English (6)	39	223.09	28.5	2.21					
		Special Education (7)	57	228.99	28.8	1.98					
		Elementary Mathematics (8)	46	230.67	28.3	3.06					
		Classroom (9)	42	211.81	27.6	4.25					
	Career-focused	Social Studies (1)	45	136.13	21.2	4.08	98.2	8	.001	.231 [.212, .250]	1<3,1<4,1<5
		Turkish (2)	33	85.08	18.6	4.69					1<7,1<9,2<3
		Science (3)	53	256.01	24.2	3.77					2<4,2<5,2<6
		Preschool (4)	48	278.06	25.2	1.71					2<7,2<8,2<9
		GPC (5)	64	284.08	25.1	3.06					3>8,4>6,4>7
		English (6)	39	201.51	23.7	2.31					4>8,5>6,5>7
		Special Education (7)	57	210.69	23.9	2.29					5>8,5>9
		Elementary Mathematics (8)	46	182.65	22.9	3.47					
		Classroom (9)	42	216.13	23.5	3.23					
	Technical Subject-focused	Social Studies (1)	45	200.27	23.4	3.89	39.9	8	.001	.094 [.075, .113]	2<3,2<4,2<5
		Turkish (2)	33	122.17	21.1	4.18					2<6,2<7,2<8
		Science (3)	53	265.80	24.8	3.28					2<9
		Preschool (4)	48	195.72	23.9	2.23					
		GPC (5)	64	261.20	24.8	2.53					
		English (6)	39	207.51	24.0	1.73					
		Special Education (7)	57	210.62	24.2	2.05					
		Elementary Mathematics (8)	46	202.55	23.7	2.56					
		Classroom (9)	42	207.62	23.6	3.16					

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Information and Communication Technologies Competency Level	ICT Competencies for Instructional Design	ICT Competencies Supporting ICT Uses	Personal-focused	Social Studies (1)	45	238.44	20.2	3.04	76.5	8	.001	.180 [.161, .199]	1>2,1>9,2<3
				Turkish (2)	33	85.14	14.6	4.81					2<4,2<5,2<6
				Science (3)	53	264.52	20.4	3.40					2<7,2<8,2<9
				Preschool (4)	48	212.85	20.2	1.85					3>7,3>9,5>7
				GPC (5)	64	268.45	20.7	2.69					5>9,6>9
				English (6)	39	236.76	20.5	1.68					
				Special Education (7)	57	192.11	19.9	1.48					
				Elementary Mathematics (8)	46	218.67	19.5	3.50					
				Classroom (9)	42	147.10	18.4	2.86					
			Social-focused	Social Studies (1)	45	227.54	16.4	2.21	57.9	8	.001	.136 [.117, .155]	2<3,2<5,2<8
				Turkish (2)	33	138.79	13.9	3.93					3>4,3>7,4<5
				Science (3)	53	259.75	16.8	2.42					4<8,5>7,5>9
				Preschool (4)	48	162.91	15.5	2.07					
				GPC (5)	64	275.40	17.2	2.29					
				English (6)	39	212.14	16.3	1.77					
				Special Education (7)	57	199.43	16.1	1.57					
				Elementary Mathematics (8)	46	241.60	16.6	2.58					
				Classroom (9)	42	156.96	14.6	3.08					
			Total Score of Information Communication Technologies	Social Studies (1)	45	300.72	47.6	6.99	144.8	8	.001	.340 [.321, .359]	1<2,1>3,1>5
				Turkish (2)	33	383.47	60.8	9.83					1>6,1>7,1>8
				Science (3)	53	158.32	39.8	8.75					1>9,2>3,2>4
				Preschool (4)	48	262.56	43.9	3.84					2>5,2>6,2>7
				GPC (5)	64	137.46	38.6	8.77					2>8,2>9,3<4
				English (6)	39	211.27	41.7	4.53					3<7,4>5,4>8
				Special Education (7)	57	223.51	42.5	4.75					4>9,5<6,5<7
				Elementary Mathematics (8)	46	183.47	41.2	7.49					5<8,5<9
				Classroom (9)	42	142.39	37.0	7.70					
			ICT Competencies Supporting ICT Uses	Social Studies (1)	45	305.12	27.5	4.73	126.6	8	.001	.300 [.281, .319]	2>3,2>4,2>5
				Turkish (2)	33	383.41	34.5	5.68					2>6,2>7,2>8
				Science (3)	53	166.92	22.3	5.13					2>9
				Preschool (4)	48	192.68	22.6	3.19					
				GPC (5)	64	156.71	22.0	5.10					
				English (6)	39	214.28	23.5	2.85					
				Special Education (7)	57	237.25	24.3	3.16					
				Elementary Mathematics (8)	46	193.38	23.3	4.81					
				Classroom (9)	42	145.10	20.4	4.92					
			ICT Competencies for Instructional Design	Social Studies (1)	45	264.01	20.1	3.13	139.4	8	.001	.327 [.308, .346]	1<2,2>3,2>4
				Turkish (2)	33	370.21	26.2	4.75					2>5,2>6,2>7
				Science (3)	53	165.75	17.5	4.08					2>8,2>9,3<7
				Preschool (4)	48	315.70	21.3	1.85					3>9,5<6,5<7
				GPC (5)	64	139.48	16.6	4.57					
				English (6)	39	203.68	18.2	2.57					

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Special Education (7)	57	202.91	18.2	2.79	
Elementary Mathematics (8)	46	187.32	18.0	3.88	
Classroom (9)	42	149.76	16.6	3.51	

Table 5. Kruskal-Wallis h test regarding teacher's candidates' levels of technostress and information and communication technology competence scores according to daily internet usage variable

Scale	Variable	Daily Internet Usage	N	Mean Rank	Mean	SD	X^2	df	p	ε^2 [%95 CI]	Difference
Teacher Candidates' Technostress Level	Total Technostress Score	Between 0-3 Hours (1)	78	250.92	115.2	4.80	11.919	2	.003	.028 [.019, .037]	1>3
		Between 4-5 Hours (2)	224	214.79	111.1	12.39					
		6+ Hours (3)	125	189.54	107.7	15.26					
	Learning Process-focused	Between 0-3 Hours	78	239.93	28.8	2.35	5.929	2	.052		-
		Between 4-5 Hours	224	214.50	28.0	3.45					
		6+ Hours	125	196.93	27.3	4.13					
	Career-focused	Between 0-3 Hours	78	250.97	24.6	2.22	13	2	.001	.031 [.022, .040]	1>3
		Between 4-5 Hours	224	216.07	23.4	3.66					
		6+ Hours	125	187.23	22.6	4.17					
	Technical Subject-focused	Between 0-3 Hours	78	233.10	24.5	2.12	2.348	2	.309		-
		Between 4-5 Hours	224	210.44	23.8	3.11					
		6+ Hours	125	208.46	23.6	3.25					
	Personal-focused	Between 0-3 Hours	78	240.47	20.6	1.67	9.494	2	.009	.022 [.013, .031]	1>3
		Between 4-5 Hours	224	218.98	19.8	3.15					
		6+ Hours	125	188.56	18.7	3.94					
	Social-focused	Between 0-3 Hours	78	230.28	16.6	1.68	2.524	2	.283		-
		Between 4-5 Hours	224	214.75	16.2	2.35					
		6+ Hours	125	202.50	15.6	3.31					
Information and Communication Technologies Competency Level	Total Score of Information Communication Technologies	Between 0-3 Hours	78	214.25	42.1	6.46	.0872	2	.957	-	
		Between 4-5 Hours	224	212.49	42.7	8.75					
		6+ Hours	125	216.55	43.9	11.43					

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ICT Competencies Supporting ICT Uses	Between 0-3 Hours	78	208.85	23.5	4.14	.575	2	.750	-
	Between 4-5 Hours	224	212.01	23.9	5.41				
	6+ Hours	125	220.78	24.8	6.82				
ICT Competencies for Instructional Design	Between 0-3 Hours	78	214.06	18.6	3.56	.019	2	.991	-
	Between 4-5 Hours	224	213.32	18.8	4.17				
	6+ Hours	125	215.19	19.2	5.20				

Table 6. Kruskal-Wallis h test regarding teacher's candidates' levels of technostress and information and communication technology competence scores according to the level of use of technological tools variable

Scale	Variable	Technological Tool Use Level	N	Mean Rank	Mean	SD	X^2	df	p	ε^2 [%95 CI]	Difference
Teacher Candidates' Technostress Level	Total Technostress Score	Bad (1)	61	277.70	115.5	10.46	49.2	2	.001	.116 [.107, .125]	1>2,1>3
		Medium (2)	273	224.07	112.8	8.49					2>3
		Good (3)	93	142.67	102.0	18.59					
	Learning Process-focused	Bad	61	275.17	29.2	3.55	30.2	2	.001	.071 [.062, .080]	1>2,1>3
		Medium	273	216.96	28.2	2.72					2>3
		Good	93	165.18	26.2	4.83					
	Career-focused	Bad	61	254.95	24.7	2.87	16.0	2	.001	.038 [.029, .047]	1>3,2>3
		Medium	273	217.79	23.8	2.74					
		Good	93	176.02	21.4	5.37					
	Technical Subject-focused	Bad	61	246.66	24.5	2.62	33.8	2	.001	.079 [.070, .088]	1>3,2>3
		Medium	273	228.56	24.3	2.46					
		Good	93	149.83	22.1	3.95					
	Personal-focused	Bad	61	253.39	20.5	2.32	30.4	2	.001	.071 [.062, .080]	1>3,2>3
		Medium	273	225.26	20.1	2.55					
		Good	93	155.10	17.6	4.62					
	Social-focused	Bad	61	239.97	16.5	2.54	27.8	2	.001	.065 [.056, .074]	1>3,2>3
		Medium	273	228.06	16.5	2.11					
		Good	93	155.69	14.7	3.36					
Information and Communication Technologies Competency Level	Total Score of Information Communication Technologies	Bad	61	127.26	36.7	6.18	56.7	2	.001	.133 [.124, .142]	1<2,1<3
		Medium	273	211.03	42.5	8.39					2<3
		Good	93	279.61	48.1	10.61					
	ICT Competencies Supporting ICT Uses	Bad	61	140.55	20.7	4.02	35.9	2	.001	.084 [.075, .093]	1<2,1<3
		Medium	273	213.99	23.9	5.17					2<3
		Good	93	262.20	26.7	6.67					
	ICT Competencies for Instructional Design	Bad	61	131.67	16.1	3.31	59.3	2	.001	.139 [.130, .148]	1<2,1<3
		Medium	273	208.05	18.6	4.08					2<3
		Good	93	285.46	21.4	4.59					

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