

Do Digital Literacy Skills Mitigate Technostress? Validation and Insights from Gen Z

Fatih Çağatay BAZ

Osmaniye Korkut Ata University, Türkiye

Alptekin DEVELİ

Tokat Gaziosmanpaşa University, Türkiye

Mustafa Fedai ÇAVUŞ

Osmaniye Korkut Ata University, Türkiye.

Although digital literacy and technostress are interrelated, a distinct research gap remains in exploring their multidimensional relationship, particularly among Generation Z students. This research investigated how various digital literacy dimensions influence technostress. The measurement tool applied here evaluates digital literacy across six specific sub-components. The construct comprises the following sub-components: ethic and responsibility, general knowledge and functional skills, daily usage, advanced production, privacy and security, and social dimension. The research is designed with a quantitative and correlational method. Data has been collected from 204 students at the Faculty of Economics and Administrative Sciences of a state university in Türkiye. The average age of this Gen Z sample was 21 ($M = 20.93$, $SD = 5.35$). The findings suggest that there is a negative correlation between general knowledge and functional skills and technostress. Moreover, having robust general knowledge and functional skills serves as a significant negative predictor of technostress. The effects of the other sub-dimensions on technostress were not significant. Another original output is the Turkish adaptation of the technostress scale. Theoretically, not all digital skills alleviate stress equally. Practically, universities should prioritize enhancing students' general knowledge and functional skills.

Keywords: cross-sectional study; digital literacy; survey technique; technostress; techno-behavior.

Coping with ongoing transformation has become an enduring challenge for individuals. Since the post–World War II period, advances in technology and digitalization, together with individuals' responses to and use of these developments, have contributed to the emergence of new theoretical perspectives. One notable example is Davis's (1989) Technology Acceptance Model. According to this model, individuals' behavioral intentions toward information systems are influenced by their perceptions of the usefulness and ease of use of such technologies. Accordingly, technology acceptance is associated with perceived utility, user-friendliness, and individual attitudes (Yahşi & Hopcan, 2021).

Technological progress has expanded the range of communication tools available to individuals and has substantially increased the volume of information produced and disseminated. As digital environments have become embedded in diverse domains, including education, healthcare, commerce, and entertainment, individuals increasingly rely on digital technologies to access and meet their everyday needs. Consequently, the ability to use digital technologies effectively and appropriately has gained increasing importance, bringing digital literacy to the forefront of contemporary research.

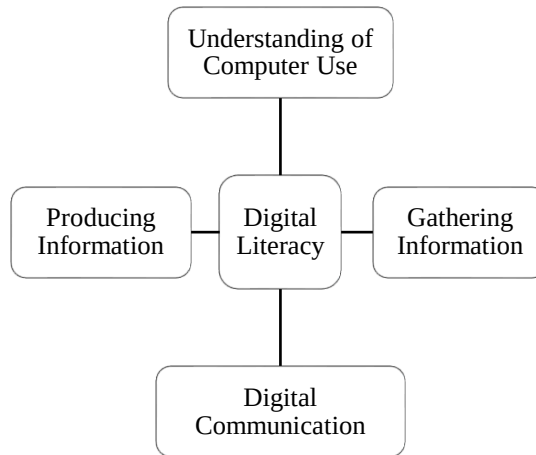
The expansion of internet-based technologies has transformed the ways in which individuals communicate, socialize, and access content and services (Onursoy, 2018). As digital technologies have become increasingly integrated into everyday life, their consequences for individuals can be both beneficial and adverse (Develi et al., 2022; Kul, 2020; Nasim et al., 2022; Özen, 2023). This situation has also raised concerns regarding the digital literacy capabilities of younger generations and has increased scholarly interest in the intersection of technology, media, and education (Onursoy, 2018). Therefore, digital literacy has emerged as an increasingly important concept in understanding individuals' interaction with digital environments.

Digital literacy encompasses the ability to access reliable information, utilize and communicate information, and generate new information through digital devices such as computers, tablets, and smartphones (Aksoy et al., 2021; Develi, 2023). The growing emphasis on lifelong learning has further strengthened the need for individuals to effectively use technological tools, particularly computers, thereby increasing the relevance of digital literacy (Özerbaş & Kuralbayeva, 2018). In addition to technological proficiency, digital literacy involves the ability to protect personal information, evaluate and benefit from reliable information sources, and communicate safely in digital environments (Gençtürk-Erdem et al., 2021).

Figure 1. shows a conceptual framework to provide an overview of the areas of digital literacy.

Figure 1

Areas of Digital Literacy



Note. Source: Wang (2024)

According to Figure 1, the areas of digital literacy are given as gathering information, digital communication, producing information and understanding of computer use. Digital literacy areas start with information gathering. It is important to gather the right information through the right channels. Readiness is necessary to determine the right information. When users do not take the information gathering step correctly in digital literacy, they will have problems in other steps. Digital communication is the process of delivering the desired message to the right address on time through the right channels after the information collection step. It is very important that digital communication is carried out securely. The issue of cyber security is also important for security to be carried out smoothly in digital environments. Users who access the right information through the right channels can produce information. In this way, computer integrity will also be ensured. With all these steps, digital literacy areas will be functional for users (Wang, 2024).

Digitally literate people are those who show the new information they obtain through digital media. Digitally literate people find information effectively, reach the correct information by distinguishing the information they find from the wrong ones through analysis, use the correct information they obtain, and synthesize new information (Hwang et al., 2023; Kozan & Bulut-Özek, 2019). Acquisition of digital literacy skills is necessary for all age groups. Being digitally literate has become a necessity in order to adapt to the transformations and developments in the media and our age.

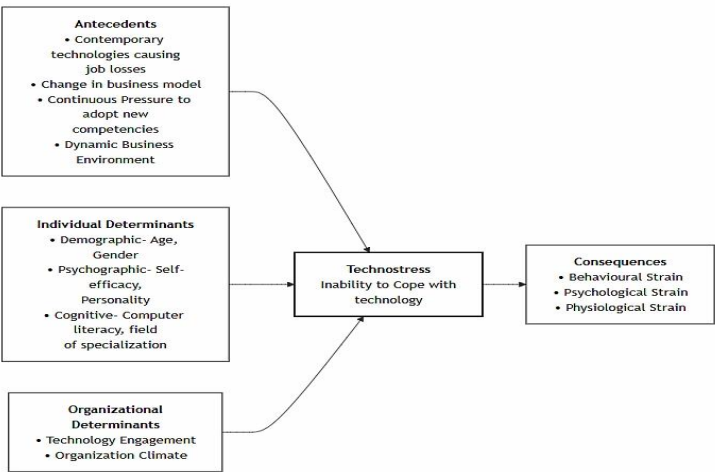
The widespread adoption of digital technologies has also brought attention to technology-related forms of stress. The term technostress is generally considered to have been introduced by clinical psychologist Craig Brod in 1984 (Brod, 1984). The concept describes a contemporary condition associated with difficulties in appropriately managing information and communication technologies (Eshet-Alkalai, 2004). From a psychological perspective, technostress can be understood as the strain that emerges when individuals have difficulty incorporating technology into their lives in a healthy and manageable manner (Tarafdar et al., 2015).

Technostress may arise when individuals perceive that they are unable to adequately meet the demands associated with digital technology use. Previous research has identified several technological stressors, including techno-complexity, techno-overload, techno-insecurity, techno-invasion, and techno-uncertainty (Tarafdar et al., 2007). Such stress may emerge when individuals’ physical, social, or cognitive needs are insufficiently addressed (Tarafdar et al., 2010). Prolonged and intensive interaction with information technologies may consequently be accompanied by various psychological and physiological difficulties. Among the psychological responses associated with technostress are anxiety, fear, anger, and worry. Laspinas (2015) further associates technostress with outcomes such as burnout, information overload, underworking, and the performance of routine tasks. The concern that computers may eventually replace human roles may also undermine employees’ motivation and sense of team spirit. Providing appropriate technical assistance and strengthening users’ technology literacy and active engagement with technological systems have therefore been proposed as ways of reducing these negative effects (Ragu-Nathan et al., 2008).

The specific conditions contributing to technostress can take different forms. Techno-overload refers to situations in which technology increases employees’ workload, the amount of information they must process, or the demand for technical competencies. *Techno-complexity* is associated with difficulties in understanding new technologies, insufficient knowledge, and limited opportunities to develop the skills required to use them effectively. *Techno-uncertainty*, in contrast, is linked to the rapid evolution of technological systems, continuous learning requirements, and frequent changes in software and hardware. Other contributing factors may include unstable or slow internet connections, difficulties experienced by customers when using technological systems, and the need to maintain continuous security measures against potential information theft (Erer, 2021).

Antecedents, determinants and consequences related to technostress are given in Figure 2.

Figure 2
Technostress Framework: Antecedents, Determinants and Consequences



Note. Source: Bhatt & Kothari (2022)

For Generation Z, digital competence is particularly relevant because university students are expected to engage with technology not only as users but also as potential creators in their future professional lives (Bukhari et al., 2023; Khan et al., 2013). Developing adequate digital literacy may consequently help students

manage technology-related demands more effectively and may contribute to limiting the negative experiences associated with technostress. From this perspective, strengthening digital literacy represents an important means of preparing university students for technology-intensive academic and professional environments.

Digital literacy is also relevant to individuals' ability to navigate the opportunities and risks of digital environments. Developing these competencies may support students in becoming more informed and responsible users of digital media while contributing to their academic engagement and success. Accordingly, examining digital literacy alongside technostress may provide a more comprehensive understanding of how students experience and respond to technology-related demands.

Against this background, the present study investigates the relationship between digital literacy and technostress among Generation Z university students. Although previous research has addressed digital literacy and technostress, digital literacy has frequently been conceptualized as a general or unidimensional competency. This approach may obscure differences among specific digital literacy capabilities. Moreover, empirical evidence concerning the relationship between the distinct dimensions of digital literacy and technostress among Generation Z university students remains limited. Therefore, this study extends the existing literature by examining the predictive effects of multiple digital literacy dimensions on technostress. In addition, the adaptation and validation of the Technostress Scale in the Turkish higher education context provides a further contribution by extending the availability of a measurement instrument for this population.

Based on the related information, the research hypotheses developed as follows, and the research model is created in Figure 3.

H_1 : Ethic and responsibility negatively predict technostress.

H_2 : General knowledge and functional skills negatively predict technostress.

H_3 : Daily usage negatively predicts technostress.

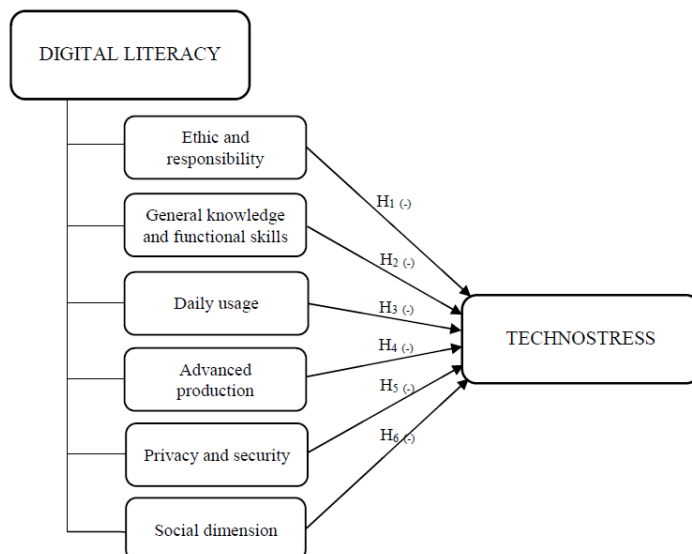
H_4 : Advanced production negatively predicts technostress.

H_5 : Privacy and security negatively predict technostress.

H_6 : Social dimension negatively predicts technostress.

Figure 3

Research Model



Method

Sample

Participants included 204 undergraduate students registered at a Turkish state university's Faculty of Economics and Administrative Sciences during the autumn semester of 2023-2024 ($n = 204$). The students in the sample took the Digital Literacy course via distance education for a 14-week period during the education and training period. The survey form prepared for the research was sent to the students electronically. University students completed the online survey voluntarily. Of the 204 students participating in the research, 97 were male (47.5%) and 107 were female (52.5%). The average age of this Generation Z (Gen Z) sample was 21 ($M = 20.93$, $SD = 5.35$). The distribution of students according to their departments is as follows: 22 students in the economics department, 31 students in the business department, 48 students in the politics and public administration department, 23 students in international relations, 51 students in international trade and logistics, and 29 students in management information systems.

Measures

The survey instrument was divided into three distinct segments. Initial questions gathered demographic data (age, gender, and department). The subsequent sections presented the digital literacy metric and the technostress inventory. The Digital Literacy Scale developed by Bayrakcı and Narmanlıoğlu (2021) was used in the research. The scale consists of 29 items and 6 dimensions which are ethic and responsibility (7 items), general knowledge and functional skills (6 items), daily usage (6 items), advanced production (2 items), privacy and security (4 items) and social dimension (4 items). Technostress scale developed by Wang, Tan, and Li (2020) to measure students' technostress levels was translated into Turkish and validated within the scope of this research. This short instrument is unidimensional and contains exactly 8 items. The Turkish translations of these questions are detailed in the *Appendix*. The five-point Likert type scales are scored between (1) strongly disagree and (5) strongly agree. Increasing scores from the scale indicate that students' digital literacy and technostress levels have increased.

Procedure

This investigation utilized a quantitative, correlational framework. Data gathering was conducted via a cross-sectional approach. Statistical evaluations were executed utilizing IBM SPSS software along with its AMOS module.

The execution of this research strictly followed established scientific ethics regarding human subjects. We ensured complete anonymity and data privacy for all respondents at every stage.

Within the scope of this research, the technostress scale developed by Wang et al., (2020) was adapted into Turkish. A specific procedure was followed in translating the items of this measurement tool, originally written in English, into Turkish to achieve an accurate linguistic conversion and to prevent any subjective bias that a solo translator might introduce (Ægisdóttir et al., 2008; Develi & Çavuş, 2024; Hambleton, 1993). For this purpose, the committee approach and parallel translation methods, which are frequently employed in cross-cultural studies to minimize errors, were adopted (Brislin, 1980; Hambleton, 2005). Accordingly, a committee was established consisting of three faculty members who are experts in the fields of management and organization, and management information systems, and who possess advanced proficiency in English. In the first stage of the process, the committee members independently translated the scale items into Turkish. In the second stage, the independent translations were compiled and subjected to a comparative analysis, where semantic differences and terminological inconsistencies were discussed. Revisions and refinements were made until a consensus was reached on the expressions that best represented the comprehensibility of the items within the context of Turkish culture, thereby giving the items their final Turkish forms.

Results

Preliminary analysis

It was found that there were no missing values in the data obtained ($MVA = 0\%$). In the test conducted for each item and variable to question the normality assumption, it was seen that the largest skewness coefficient was -2.10, and the largest kurtosis coefficient was 7.44. These coefficients showed that distributional normality was confirmed because the values remained within the ± 3 skewness and ± 10 kurtosis limits (Kline, 2011). Finally, to screen for potential common method variance, Harman's single-factor assessment was executed (Harman, 1979). All items examined with non-rotation principal component analysis exhibited a multidimensional structure consisting of 7 dimensions, and the single-factor structure of the items explained not the majority of the total variance but a low part of 31.07% ($s^2 < .50$; Develi et al., 2022). Accordingly, it was concluded that the possible common method bias in the data was not a problem (Podsakoff et al., 2003).

Validity analysis

Confirmatory factor analysis was conducted to test the validity of the measurement instruments based on their fit with the data. In the applied analyses, the 0.50 criterion suggested by Hair et al. was taken into consideration as the lower limit criterion for factor loading (Hair et al., 2014). Therefore, one item belonging to the ethic and responsibility dimension, one item belonging to the daily usage dimension, and two items belonging to the advanced production dimension (i.e., the dimension itself) were removed from the model. The results obtained are shown in Table 1.

Table 1

Results of the validity analysis

Measures	χ^2	p	χ^2/df	CFI	SRMR	Factor loadings
Digital literacy (first-order correlated)	532.208	.000	2.039	.902	.068	(.540 - .863)***
Technostress	62.907	.000	3.700	.959	.050	(.644 - .838)***

Note. $n = 204$, χ^2 : Chi-square, p : Statistical significance level, χ^2/df : Chi-square/degrees of freedom, CFI : Comparative fit index, $SRMR$: Standardized root mean square residual.

*** $p < .001$.

The result of the confirmatory factor analysis demonstrates that all measures provided the desired goodness of fit indexes (Anderson & Gerbing, 1984; Kline, 2011; Tabachnick & Fidell, 2013).

Reliability analysis

Both corrected item-total correlations and Cronbach's alpha metrics were evaluated to establish the reliability of the measurement tools. The findings are shown in Table 2.

Table 2

Results of the reliability analysis

Measures	Item quantities	Corrected item-total correlations	Cronbach alfa
Ethic and responsibility	6	.663 - .803	.903
General knowledge and functional skills	6	.573 - .694	.853
Daily usage	5	.557 - .694	.818
Privacy and security	4	.604 - .670	.809
Social dimension	4	.489 - .567	.727
Technostress	8	.649 - .800	.921

The findings revealed that item-total correlations exceeded the 0.30 threshold, demonstrating that the relationship between the general structure of the scales and the items is at a sufficient level (Field, 2009). In addition, since Cronbach's alpha (α) coefficients meet the threshold value of $\alpha > .70$, all measures are reliable (Cronbach, 1951; Nunnally, 1978).

Hypothesis testing

Correlation analysis

Correlation analysis was performed to test whether the research concepts change together. The results obtained are seen in Table 3.

Table 3

Results of the correlation analysis

Variables	M	SD	1	2	3	4	5	6
1. Ethic and responsibility	4.287	.689	1					
2. General knowledge and functional skills	3.633	.840	.518**	1				
3. Daily usage	4.152	.685	.698**	.630**	1			
4. Privacy and security	4.273	.649	.696**	.549**	.763**	1		
5. Social dimension	3.504	.831	.368**	.541**	.526**	.543**	1	
6. Technostress	2.463	.931	-.036	-.189**	-.100	-.097	.008	1

Note. $n = 204$, M : Mean, SD : Standard deviation

* $p < .05$, ** $p < .01$

The correlation outcomes demonstrated that a statistically significant association only exists between general knowledge and functional skills and technostress ($r = -.189$, $p < .01$). Accordingly, it is understood that the general knowledge and functional skills, which is a dimension of digital literacy, increase, their technostress levels will decrease. The other relationships between the variables are statistically insignificant ($p > .05$).

Regression analysis

A regression analysis evaluated how well the independent variables predicted the dependent construct. The results obtained are seen in Table 4.

Table 4

Results of the regression analysis

Independent variables	Dependent variable	β	R^2	Adj. R^2	F	$D-W$	VIF
Ethic and responsibility	Technostress	.148	.064	.041	2.729*	1.902	2.292
General knowledge and functional skills		-.281**					1.885
Daily usage		-.029					3.155
Privacy and security		-.127					2.957
Social dimension		.189					1.652

Note. $n = 204$, β : Standardized beta coefficient, R^2 : Coefficient of determination, Adj. R^2 : Adjusted coefficient of determination, F : F -statistic, $D-W$: Durbin-Watson coefficient, VIF : Variance inflation factor.

* $p < .05$, ** $p < .01$

According to the regression analysis results, firstly, the variance inflation factor coefficients show that multicollinearity is not a problem ($VIF < 5$) in the model (O'Brien, 2007). In addition, the Durbin-Watson coefficient proves that there is no autocorrelation problem ($D-W < 2$; Durbin & Watson, 1971). Digital literacy dimensions significantly predicted technostress ($F = 2.729$, $p < .05$). Accordingly, the digital literacy dimensions explain 04% of technostress (Adj. $R^2 = .041$). When the effect of each dimension on technostress is analyzed, it is seen that the only significant effect belongs to the general knowledge and functional skills dimension ($\beta = -.281$, $p < .01$). Accordingly, the general knowledge and functional skills dimension contributes negatively to explaining technostress. The H_2 hypothesis was supported, but the rest was not supported.

Discussion and Conclusions

This paper investigated how different digital literacy dimensions might predict technostress. According to the results obtained, there is a negative correlation between general knowledge and functional skills and technostress. In addition, general knowledge and functional skills contribute negatively to explaining technostress. Another original output of the study is that the technostress scale used was adapted into Turkish.

Lots of research indicates a complex relationship between digital literacy and technostress. On the one hand, higher levels of digital literacy can mitigate technostress by empowering individuals to effectively manage digital tools and information overload (Muslimin et al., 2023). Individuals with advanced digital skills are better equipped to filter and prioritize information, thus reducing feelings of overwhelm and anxiety. Additionally, digital literacy enables individuals to adopt adaptive coping strategies, such as mindfulness practices and digital detoxes, to counteract the negative effects of technology (Lim & Teh, 2026). Conversely, inadequate digital literacy can exacerbate technostress by increasing individuals' susceptibility to information overload, cyberbullying, and privacy concerns (Lei et al., 2020). For instance, individuals with limited digital skills may struggle to discern credible sources of information online, leading to heightened anxiety and confusion. Moreover, they may face challenges in safeguarding their personal data and privacy in an increasingly digitalized world, further contributing to technostress.

Improving one's digital literacy is crucial for utilizing technology's advantages and efficiently handling technostress. People can traverse the digital environment with more resilience and confidence by learning essential digital literacy skills like information assessment and online safety procedures (Livingstone & Helsper, 2007). Furthermore, digital self-care and mindful technology use are hallmarks of a healthy digital mindset, which can enhance psychological well-being and lessen the negative effects of technostress (Can & Aydın, 2022; Rikard et al., 2016).

The findings of this study reveal that among the six dimensions of digital literacy, only general knowledge and functional skills significantly and negatively predict technostress. This specific result suggests that for Gen Z university students, possessing fundamental and practical technical competence is the primary buffer against technology-related strain. While this generation is often characterized by high social media engagement and advanced content production, these activities do not necessarily alleviate the stress associated with academic or technical technology use. Instead, the ability to troubleshoot functional issues, navigate software interfaces effectively, and possess the know-how of digital tools (functional skills) directly reduces the frustration and sense of inadequacy that leads to technostress. In other words, for Gen Z, social or ethical digital awareness may be a lifestyle norm, but functional proficiency is the actual tool for stress management in a digital learning environment. This explains why other dimensions, despite their importance in digital citizenship, did not show a statistically significant impact on reducing stress levels in this particular sample.

In the higher education context, promoting digital literacy among students is crucial for fostering a productive and resilient learning environment. Universities should move beyond providing general IT infrastructure and instead offer targeted training programs that enhance students' functional digital skills. By equipping students with the necessary technical troubleshooting competencies and software proficiency, educational institutions can mitigate technostress-related academic burnout and 'inaction thoughts'. Additionally, university policies should prioritize student well-being by integrating digital self-care modules into the curriculum, thereby helping Gen Z navigate the heavy reliance on technology-enhanced learning without compromising their mental health.

At a societal level, addressing the digital divide is essential for promoting equitable access to digital literacy resources and reducing technostress disparities (DiMaggio & Hargittai, 2001). Efforts to bridge the digital divide should focus not only on providing access to technology but also on fostering digital literacy skills among marginalized populations (Warschauer, 2003). By empowering individuals from diverse socio-economic backgrounds with digital literacy, society can mitigate the negative consequences of technostress and promote greater digital inclusion and participation (Van Dijk, 2005).

While offering valuable insights, the current research presents certain limitations that pave the way for subsequent investigations. Initially, the participant group was restricted to 204 students from a single faculty

at a state university in Türkiye. While this provides a targeted insight into Gen Z, the findings may not be fully generalizable to students in different geographic regions, private institutions, or diverse socio-economic backgrounds. Subsequent scholars are encouraged to utilize broader and heterogeneous groups to enhance generalizability and examine the digital divide broadly.

Second, the research model focused primarily on the direct predictive relationship between digital literacy dimensions and technostress. As noted in the literature, technostress is a complex phenomenon influenced by various individual and organizational factors. Future research could expand this model by incorporating variables such as self-efficacy, specific coping strategies, or technology anxiety as mediators or moderators to provide a more holistic understanding.

Finally, this study utilized a cross-sectional design, which captures a snapshot of the relationship at a specific point in time. Longitudinal studies are recommended to elucidate the dynamic interplay and causal relationships between digital literacy interventions and technostress outcomes over time. Additionally, incorporating qualitative research methods, such as interviews or focus groups, could capture the nuanced experiences and perceptions of individuals, informing more evidence-based strategies for digital well-being.

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Appendix

The Turkish version of the items from the scale developed by Wang et al. (2020), validated in this study.

1. Teknoloji destekli öğrenmeye uyum sağlamak için stresli hissediyorum.
2. Sınırlı zaman ve çabam nedeniyle teknoloji destekli öğrenmeyi etkin bir şekilde kullanmakta zorlanıyorum.
3. Mevcut kapasitemle teknoloji destekli öğrenimin yüksek beklentileriyle başa çıkma konusunda stresli hissediyorum.
4. Teknoloji destekli öğrenmenin gerekliliklerini karşılamak için mevcut öğrenme alışkanlığımı ve tercihimini değiştirmekte zorlanıyorum.
5. Teknoloji destekli öğrenmenin eğitimimin her alanına yayılmasından rahatsızım.
6. Teknoloji destekli öğrenmenin çok çeşitli olması beni rahatsız ediyor.
7. Teknoloji destekli öğrenmenin çeşitli biçimleri çalışmamı zorlaştırdığı için kendimi stresli hissediyorum.
8. Okulumda teknoloji destekli öğrenime olan yoğun bağımlılık normal çalışma düzenimi bozduğu için kendimi stresli hissediyorum.

Not. Ölçüm düzeyi: (1) Kesinlikle katılmıyorum, (2) Katılmıyorum, (3) Ortadayım, (4) Katılıyorum, (5) Kesinlikle katılıyorum.