# Examining the Technostress Levels of Biology Teachers*

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**To Cite:** Yıldız, C. & Yapıcı, İ. Ü. (2026). Examining the technostress levels of biology teachers. *Malaysian Online Journal of Educational Technology, 14*(1), 13-26. http://dx.doi.org/10.52380/mojet.2026.14.1.630

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***This article was produced from the master's thesis prepared by the first author under the supervision of the second author.**

## ABSTRACT

Technostress is the stress that emerges from difficulties in coping with the use and integration of information and communication technologies.The purpose of this study is to determine the technostress levels of biology teachers and to examine whether these levels differ according to various demographic variables (gender, age, education level, seniority, weekly lesson hours, years of ICT use and daily ICT usage time for educational purposes). The study employed a descriptive survey model, one of the quantitative research designs. The study group consisted of 99 biology teachers working in public schools in a city in southeastern Türkiye during the 2022–2023 academic year. The participants were selected using random sampling, and participation was based on voluntary consent. Data were collected using a "Personal Information Form" and the "Teachers' Technostress Levels Defining Scale" developed by Çoklar et al. (2017). Since the data were normally distributed, parametric tests (independent samples t-test and one-way ANOVA) were used in the analyses. The results revealed that biology teachers generally reported a moderate level of technostress. No significant differences were found in terms of gender, age, educational level and weekly teaching hours; however, significant differences were identified in relation to seniority, years of ICT use, and daily ICT usage time for educational purposes. In particular, teachers who were new to the profession and those with fewer years of ICT experience reported higher levels of technostress.The effect size analyses indicated that the observed differences generally reflected a moderate impact ($\eta^2$), suggesting that the identified variables had a meaningful but not large influence on technostress levels. It can be said that increasing teachers' digital competencies and strengthening technical support mechanisms can help reduce technostress.

**Keywords:** *Technostress, biology teachers, digital competence, ICT.*

***Article History:***
Received: 14 November 2025
Received in revised form: 21 Dec 2025
Accepted: 1 January 2026
Article type: Research Article

## INTRODUCTION

With the rapid advancement of technology, radical changes are occurring in the ways we access information and in learning methods. The fact that the digital generation lives in close interaction with technology has revealed the necessity for educational systems to adapt to this transformation by updating themselves and implementing innovative teaching approaches. Consequently, technology integration in education has become an integral and indispensable component of modern teaching processes (Scherer et al., 2019).

Technological tools and materials used in the teaching process are important elements that contribute to the effective realization of learning. Today, the rapid pace of technological advancements requires individuals to be able to follow these changes and integrate them into their daily lives. Therefore, keeping up with technology and integrating it into teaching processes has become a fundamental skill to acquire (Caena & Redecker, 2019). It is crucial for educators, in particular, to possess these skills in order to impart these competencies to students (Kaya, 2020). Teachers must possess a basic level of technological knowledge and competencies to equip students with the ability to use technology effectively. Furthermore, it is crucial that they acquire the skills to design and develop appropriate digital materials to support teaching processes (Gökbulut, Keserci, & Akyüz, 2021).

While new technologies allow for more work to be done in a shorter time, they can also increase workload and strain individuals due to the knowledge and competence requirements. Expecting employees to produce more work in a shorter time using technology impacts their interpersonal communication and leads to behavioral changes (Ragu-Nathan et al., 2008). In this context, the unpredictable negative psychological effects of technology create a condition called technostress (Ayyagari, 2007; Maier, 2014; Salanova et al., 2014).

The concept of technostress was first defined by Brod (1984) as a modern adaptation problem resulting from individuals' inability to cope healthily with new information and communication technologies (Dragano & Lunau, 2020). This concept refers to the psychological, behavioral, and physiological pressures that technological innovations create on individuals. Research reveals that technological developments directly or indirectly create anxiety, negative perceptions, and behaviors in individuals (Weil & Rosen, 1997). Sami and Iffat (2010) defined technostress as the fear and anxiety users experience regarding new technologies. Similarly, Salanova et al. (2007) defined technostress as an adaptation problem that adversely affects a person's psychological state and future technology use, resulting in feelings of anxiety, mental fatigue, skepticism, and inadequacy.

Tarafdar et al. (2011) grouped the causes of technostress into five sub-dimensions: techno-uncertainty, techno-invasion, techno-insecurity, techno-complexity, and techno-overload. *Techno-uncertainty* refers to the discomfort experienced by individuals as a result of the constant change and advancement of technology, which makes it difficult for them to access up-to-date information adequately and to keep pace with these innovations. *Techno-invasion* refers to the phenomenon in which the expansion of work life through technological advancements causes individuals to simultaneously engage in both their professional and personal lives. This situation blurs the boundaries between work and private life, leading to increased stress, tension, and discomfort among individuals. In other words, the excessive intrusion of technology into personal spaces causes people to feel constantly connected to work and reduces their opportunities for rest and recovery. *Techno-insecurity* refers to the stress and anxiety employees may feel when their employers prefer colleagues who are more skilled with new technologies, creating fear of job loss and a sense of workplace insecurity. *Techno-complexity* refers to the anxiety individuals experience due to the ongoing evolution of technology and the expectation to possess the technical skills required to use new software, hardware, and applications. *Techno-overload* refers to the stress and difficulties users face due to constant information flow from business information systems, leading to information overload, reduced concentration, and multitasking demands (Ayyagari vd., 2011; Ali vd., 2019; Florkowski, 2019; Sollo, 2016; Tarafdar vd., 2011; Wang &Li , 2019)

Technostress can lead to negative thinking, mental noise, difficulty concentrating, reduced analytical and decision-making abilities, sleep disturbances, and psychological issues such as anxiety, depression, burnout, and panic attacks. It may also contribute to physical health problems, including headaches, musculoskeletal pain, hypertension, heart conditions, and gastrointestinal disorders (Mahboob & Khan, 2016; Tu et al., 2007).

The increasing use of technology in education significantly affects teachers' daily workflows and may lead to stress due to heightened expectations regarding technology integration (Çoklar et al., 2016). This stress influences teachers' perceptions of and attitudes toward new technologies, potentially leading to resistance to innovation and negatively affecting job performance (Al-Fudail & Mellar, 2008; Effiyanti & Sagala, 2018). Therefore, identifying teachers' technostress levels has become an important issue in educational research. Although studies examining teachers' technostress have increased in recent years (Arslan, 2022; Kıncı & Özgür, 2021; Soy, 2023; Tanyıldız, 2024; Tunç, 2022), these studies generally focus on teachers from different disciplines as a single group or address general teaching populations. Subject-specific investigations remain limited, particularly in the field of biology education, where technology use is intensive due to digital simulations, virtual laboratories, and data analysis tools. Despite this technological intensity, no empirical study has been found that specifically examines the technostress levels of biology teachers. Addressing this gap is important for developing discipline-specific professional support and technology integration strategies. Accordingly, the aim of this study is to determine the technostress levels of biology teachers and to examine these levels in relation to various demographic variables. For this purpose, the answers to the following research questions have been sought: (i) What are the technostress levels of biology

teachers? (ii) Do biology teachers' technostress levels differ significantly according to gender? (iii) Do biology teachers' technostress levels differ significantly according to educational level? (iv) Do biology teachers' technostress levels differ significantly according to age? (v) Do biology teachers' technostress levels differ significantly according to seniority? (vi) Do biology teachers' technostress levels show a significant difference according to weekly lesson hours? (vii) Do biology teachers' technostress levels show a significant difference according to the years of ICT use? (viii) Do biology teachers' technostress levels show a significant difference according to the daily ICT usage for educational purposes?

## RESEARCH METHOD

### Research Model

This study utilized a descriptive survey model, in which participants' responses are directly recorded without guidance, allowing the current situation to be described. Descriptive studies typically aim to explain existing conditions, evaluate them based on specific criteria, and identify relationships between variables (Büyüköztürk et al., 2012).

### Participants

The study group consisted of 99 biology teachers working in high schools affiliated with the Ministry of National Education during the 2022-2023 academic year.The participants were selected using random sampling, and participation was based on voluntary consent. Demographic data for the study group is provided in Table 1.

**Table 1.** *Descriptive Statistical Information of the Study Group According to Variables*

| Variable | Group | N | % |
|---|---|---|---|
| Gender | Female | 68 | 68.7 |
| | Male | 31 | 31.3 |
| Age | 20–29 | 29 | 29.3 |
| | 30–39 | 61 | 61.6 |
| | 40 and above | 9 | 9.1 |
| Education Level | Undergraduate | 73 | 73.7 |
| | Graduate | 26 | 26.3 |
| Seniority | 1–5 years | 34 | 34.3 |
| | 6–10 years | 44 | 44.4 |
| | 11–15 years | 17 | 17.2 |
| | 16 years and above | 4 | 4.1 |
| Weekly Lesson Hours | 10–20 hours | 28 | 28.3 |
| | 21–30 hours | 49 | 49.5 |
| | 31–40 hours | 20 | 20.2 |
| | 41 hours and above | 2 | 2.0 |
| Years of ICT Use | 1–5 years | 22 | 22.2 |
| | 6–10 years | 37 | 37.4 |
| | 11–15 years | 25 | 25.3 |
| | 16 years and above | 15 | 15.1 |
| Daily ICT Usage Time for Educational Purpose | Less than 1 hour | 17 | 17.2 |
| | 1–2 hours | 30 | 30.3 |
| | 3–4 hours | 47 | 47.4 |
| | 5 hours and above | 5 | 5.1 |

Table 1 presents the descriptive statistical information of the study group according to key demographic and professional variables. The study group predominantly consists of female teachers, mostly aged 30–39, holding an undergraduate degree and having moderate professional experience (6–10 years). Most participants teach 21–30 hours per week, report 6–10 years of ICT experience, and use ICT for educational purposes 3–4 hours daily. Overall, the sample represents teachers in the mid-career stage who are regular and active users of ICT in their professional practice.

### Data Collection Tools

*Personal Information Form:* A personal information form was used to determine the characteristics of the participating teachers. This personal information form includes eight questions regarding participants' gender, age, education level, seniority, weekly lesson hours, years of ICT (information and communication technologies) use, and daily ICT use for educational purposes.

*Teachers' Technostress Levels Defining Scale:* The scale developed by Çoklar et al. (2017) consists of 28 items and five factors: *learning–teaching process oriented* (F1, 7 items), *profession oriented* (F2, 6 items), *technical issue oriented* (F3, 6 items), *personal oriented* (F4, 5 items), and *social oriented* (F5, 4 items). The items are rated on a 5-point Likert scale ranging from “strongly disagree” to “strongly agree.” In the present study, the overall reliability coefficient (Cronbach’s alpha) of the scale was calculated as .92, indicating high internal consistency. The Cronbach’s alpha coefficients for the sub-dimensions were .77 for learning–teaching process oriented, .82 for profession oriented, .89 for technical issue oriented, .81 for personal oriented, and .75 for social oriented dimensions. All items are positively worded, and there are no reverse-coded items.The interpretation of the results obtained from the data analysis was based on calculations made using the arithmetic mean score. The criteria used to evaluate teachers' technostress levels in terms of various factors depending on the scale are given Table 2.

**Table 2.** *Evaluation Criteria for Scores Obtained from the Teachers' Technostress Levels Defening Scale*

| Evaluation Range | Evaluation Criteria |
|---|---|
| 1.00 – 2,33 | Low level |
| 2.34 – 3.67 | Medium level |
| 3.68 – 5.00 | High level |

### Data Analysis

The Kolmogorov-Smirnov test was applied to determine whether the data exhibited a normal distribution. The obtained values are shown in Table 3.

**Table 3.** *Kolmogorov-Smirnov Test Results of the Data*

| | F1 | F2 | F3 | F4 | F5 | Average |
|---|---|---|---|---|---|---|
| N | 99 | 99 | 99 | 99 | 99 | 99 |
| Kol-Smir. Z | 1.080 | 1.210 | 1.195 | 1.058 | .904 | .873 |
| p | .194 | .107 | .115 | .213 | .387 | .432 |

Calculated p values greater than .05 are interpreted as indicating that the scores at this significance level don’t significantly deviate from the normal distribution and are appropriate. Based on the obtained values, the data were determined to have a normal distribution, and therefore, parametric tests were used in the analysis of the data. The homogeneity of variances was tested using Levene’s test, and the results indicated that the assumption was met. Accordingly, one-way analysis of variance (ANOVA) was employed to examine differences between groups. When a statistically significant F value was obtained, post-hoc multiple comparison analyses were conducted using the Tukey HSD test in order to determine which groups differed from each other.Depending on the value of the effect size, $.01 \leq \eta 2 < .06$ was interpreted as a "low-level effect," $.06 \leq \eta 2 < .14$ as a "moderate-level effect," and $\eta 2 \geq 0.14$ as a "large-level effect" (Cohen, 1988).

## FINDINGS

The first sub-problem of the research aims to obtain answers to the question, " *What are the technostress levels of biology teachers?* " For this purpose, firstly, general descriptive statistics regarding biology teachers' technostress levels are presented.

Table 4 presents the descriptive statistics regarding the technostress levels of biology teachers. The findings indicate that the overall technostress level of teachers is at a moderate level (2.47). When the sub-dimensions are examined, technical issue–oriented technostress (F3) has the highest mean score (2.80). This finding suggests that teachers experience higher levels of technostress particularly due to technical

infrastructure, hardware, and software-related problems. This is followed by social-oriented technostress (F5) (2.74) and learning–teaching process–oriented technostress (F1) (2.63). These results imply that the integration of technology into instructional processes and its impact on social interactions create a certain level of stress for teachers. In contrast, profession-oriented technostress (F2) has the lowest mean score (1.96), indicating that biology teachers' perceptions of technology-related stress associated with their professional roles and careers are relatively low. Personal-oriented technostress (F4) shows a low-to-moderate mean level (2.24).

**Table 4.** *Descriptive Statistics Regarding Technostress Levels of Biology Teachers*

| Code | Factors | N | Min | Max | Mean | SD |
|---|---|---|---|---|---|---|
| F1 | Learning-Teaching Process Oriented | 99 | 1.00 | 4.42 | 2.63 | 0.73 |
| F2 | Profession Oriented | 99 | 1.00 | 4.83 | 1.96 | 0.75 |
| F3 | Technical Issue Oriented | 99 | 1.00 | 5.00 | 2.80 | 1.02 |
| F4 | Personal Oriented | 99 | 1.00 | 5.00 | 2.24 | 0.86 |
| F5 | Social Oriented | 99 | 1.00 | 4.75 | 2.74 | 0.90 |
| Average | | 99 | 1.00 | 4.53 | 2.47 | 0.67 |

The second sub-problem of the research aims to obtain answers to the question " *Do biology teachers' technostress levels differ significantly according to gender? "*

**Table 5.** *Independent Samples T-test Results on Technostress Levels of Biology Teachers by Gender*

| Factors | Gender | n | M | SD | df | t | p |
|---|---|---|---|---|---|---|---|
| Technostress Levels (Average) | Female | 68 | 2.48 | 0.71 | 97 | 0.25 | 0.80 |
| | Male | 31 | 2.44 | 0.57 | | | |
| F1 | Female | 68 | 2.67 | 0.74 | 97 | 0.76 | 0.45 |
| | Male | 31 | 2.54 | 0.73 | | | |
| F2 | Female | 68 | 2.00 | 0.81 | 97 | 0.83 | 0.41 |
| | Male | 31 | 1.87 | 0.62 | | | |
| F3 | Female | 68 | 2.74 | 1.08 | 97 | -0.80 | 0.42 |
| | Male | 31 | 2.92 | 0.85 | | | |
| F4 | Female | 68 | 2.26 | 0.86 | 97 | 0.39 | 0.69 |
| | Male | 31 | 2.19 | 0.87 | | | |
| F5 | Female | 68 | 2.74 | 0.96 | 97 | 0.63 | 0.95 |
| | Male | 31 | 2.73 | 0.77 | | | |

When Table 5 is examined, the mean technostress scores of male teachers were found to be 2.44, and the mean technostress scores of female teachers were found to be 2.48. According to these results, there was no significant difference between the technostress levels of female and male teachers ($t_{(99)} = 0.251$, $p > .05$). In addition, it was found that female teachers had the highest mean scores in the factor measured for social oriented among the sub-factors of the scale (2.74), while the mean scores of female teachers in the technostress sub-factor measured for the profession oriented were found to be the lowest (2.00). It was also found that male teachers had the highest mean values measured for social oriented (2.73), and the lowest mean values measured for the profession oriented (1.87).

The third sub-problem of the research aims to obtain answers to the question " *Do biology teachers' technostress levels differ significantly according to their education level? "*

**Table 6.** *Independent Samples T-Test Results on Technostress Levels of Biology Teachers by Educational Level*

| Factors | Gender | n | M | SD | df | t | p |
|---|---|---|---|---|---|---|---|
| Technostress Levels (Average) | Undergraduate | 73 | 2.50 | 0.65 | 97 | 0.90 | 0.37 |
| | Graduate | 26 | 2.36 | 0.72 | | | |
| F1 | Undergraduate | 73 | 2.64 | 0.73 | 97 | 0.27 | 0.79 |
| | Graduate | 26 | 2.59 | 0.75 | | | |
| F2 | Undergraduate | 73 | 1.98 | 0.75 | 97 | 0.47 | 0.63 |
| | Graduate | 26 | 1.90 | 0.77 | | | |
| F3 | Undergraduate | 73 | 2.82 | 1.02 | 97 | 0.42 | 0.67 |
| | Graduate | 26 | 2.73 | 1.01 | | | |
| F4 | Undergraduate | 73 | 2.31 | 0.84 | 97 | 1.37 | 0.17 |
| | Graduate | 26 | 2.04 | 0.91 | | | |
| F5 | Undergraduate | 73 | 2.81 | 0.92 | 97 | 0.90 | 0.36 |
| | Graduate | 26 | 2.52 | 0.85 | | | |

When Table 6 is examined, the average technostress score of teachers with graduate degrees was found to be 2.36, and the average technostress score of teachers with undergraduate degrees was found to be 2.50. According to these results, it was revealed that there was no significant difference between the technostress levels in terms of teachers' education level ($t_{(99)} = 0.908$, $p > .05$). In addition, it was found that the average scores in the sub-factor measured for technical issue oriented among the sub-factors of the scale were the highest in bachelor's degree holders ( 2.82), and the technostress levels measured in terms of the same factor were also the highest in master's degree holders (2.73); In the technostress sub-factor measured for the profession oriented, it was found that the average technostress score of teachers with a bachelor's degree was the lowest ( 1.98), and in terms of the same factor, the technostress average score of teachers with a master's degree was the lowest ( 1.90).

The fourth sub-problem of the research aims to obtain answers to the question " *Do biology teachers' technostress levels differ significantly according to age? "*

**Table 7.** *ANOVA Results on Technostress Levels of Biology Teachers by Age*

| Factors | Source of Variance | Sum of Squares | df | Mean Square | F | p |
|---|---|---|---|---|---|---|
| F1 | Between Groups | 0.428 | 2 | 0.21 | 0.39 | 0.68 |
| | Within Groups | 52.841 | 96 | 0.55 | | |
| | Total | 53.269 | 98 | | | |
| F2 | Between Groups | 0.024 | 2 | 0.01 | 0.02 | 0.98 |
| | Within Groups | 56.436 | 96 | 0.59 | | |
| | Total | 56.460 | 98 | | | |
| F3 | Between Groups | 1.412 | 2 | 0.70 | 0.67 | 0.51 |
| | Within Groups | 99.830 | 96 | 1.04 | | |
| | Total | 101.242 | 98 | | | |
| F4 | Between Groups | 1.602 | 2 | 0.80 | 1.70 | 0.34 |
| | Within Groups | 71.722 | 96 | 0.75 | | |
| | Total | 73.324 | 98 | | | |
| F5 | Between Groups | 0.633 | 2 | 0.32 | 0.38 | 0.68 |
| | Within Groups | 79.424 | 96 | 0.83 | | |
| | Total | 80.057 | 98 | | | |
| Technostress Level (Overall) | Between Groups | 0.387 | 2 | 0.19 | 0.42 | 0.65 |
| | Within Groups | 43.732 | 96 | 0.46 | | |
| | Total | 44.119 | 98 | | | |

1: 20-29 years old 2: 30-39 years old 3: 40 years old and above

When Table 7 was examined, it was revealed that there was no difference in the technostress levels of biology teachers based on the age factor ($F_{(2-96)} = 0.425$, $p>.05$). However, it was also revealed that each

factor in the scale was considered separately and no significant difference occurred between the average results of these factors.

The fifth sub-problem of the research aims to obtain answers to the question " *Do biology teachers' technostress levels differ significantly according to seniority? "*

**Table 8.** *ANOVA Results on Technostress Levels of Biology Teachers by Seniority*

| Factors | Source of Variance | Sum of Squares | df | Mean Square | F | p | Difference | $\eta^2$ |
|---|---|---|---|---|---|---|---|---|
| F1 | Between Groups | 2.594 | 3 | 0.87 | 1.62 | 0.19 | | |
| | Within Groups | 50.675 | 95 | 0.53 | | | | |
| | Total | 53.269 | 98 | | | | | |
| F2 | Between Groups | 4.265 | 3 | 1.42 | 2.58 | 0.06 | | |
| | Within Groups | 52.195 | 95 | 0.55 | | | | |
| | Total | 56.460 | 98 | | | | | |
| F3 | Between Groups | 6.579 | 3 | 2.19 | 2.20 | 0.09 | | |
| | Within Groups | 94.664 | 95 | 0.99 | | | | |
| | Total | 101.242 | 98 | | | | | |
| F4 | Between Groups | 4.949 | 3 | 1.66 | 2.31 | 0.08 | | |
| | Within Groups | 68.336 | 95 | 0.72 | | | | |
| | Total | 73.324 | 98 | | | | | |
| F5 | Between Groups | 4.210 | 3 | 1.40 | 1.76 | 0.16 | | |
| | Within Groups | 75.847 | 95 | 0.79 | | | | |
| | Total | 80.057 | 98 | | | | | |
| Technostress Level (Overall) | Between Groups | 3.781 | 3 | 1.26 | 2.97 | 0.04 | 1 > 3 | 0.08 |
| | Within Groups | 40.338 | 95 | 0.42 | | | | |
| | Total | 44.119 | 98 | | | | | |

1: 1-5 years 2: 6 -10 years 3: 11-15 years 4: 16 years and above

When Table 8 is examined, when the technostress levels of biology teachers are evaluated according to the seniority factor, it is revealed that there is no difference when the sub-factors are considered separately, but a significant difference is observed when the general average is examined ($F_{(3-95)} = 2.968$, $p < .05$). When the average scores of teachers with 1-5 years of seniority and those with 11-15 years of seniority are examined, it is concluded that there is a significant difference and this difference is in favor of 1 (1-5 years). The effect of the seniority variable on the scale as a whole is medium ($.06 \leq \eta^2 < .14$).

The sixth sub-problem of the research aims to obtain answers to the question " *Do biology teachers' technostress levels show a significant difference according to weekly lesson hours? "*

**Table 9.** *ANOVA Results on Technostress Levels of Biology Teachers by Weekly Lesson Hours*

| Factors | Source of Variance | Sum of Squares | df | Mean Square | F | p |
|---|---|---|---|---|---|---|
| F1 | Between Groups | 0.771 | 3 | 0.25 | 0.46 | 0.71 |
| | Within Groups | 52.498 | 95 | 0.55 | | |
| | Total | 53.269 | 98 | | | |
| F2 | Between Groups | 1.102 | 3 | 0.37 | 0.63 | 0.598 |
| | Within Groups | 55.357 | 95 | 0.58 | | |
| | Total | 56.460 | 98 | | | |
| F3 | Between Groups | 5.560 | 3 | 1.85 | 1.84 | 0.14 |
| | Within Groups | 95.683 | 95 | 1.00 | | |
| | Total | 101.242 | 98 | | | |
| F4 | Between Groups | 0.385 | 3 | 0.13 | 0.17 | 0.92 |
| | Within Groups | 72.940 | 95 | 0.77 | | |
| | Total | 73.324 | 98 | | | |
| F5 | Between Groups | 0.824 | 3 | 0.27 | 0.3 | 0.80 |
| | Within Groups | 79.233 | 95 | 0.83 | 3 | |
| | Total | 80.057 | 98 | | | |
| Technostress Level (Overall) | Between Groups | 1.198 | 3 | 0.40 | 0.89 | 0.45 |
| | Within Groups | 42.921 | 95 | 0.45 | | |
| | Total | 44.119 | 98 | | | |

1: Between 10 and 20 hours 2: Between 21 and 30 hours 3: Between 31 and 40 hours 4: 41 hours and above

When Table 9 is examined, it is revealed that when biology teachers' technostress levels are considered according to weekly lesson hours, the overall average is $F_{(3\text{-}95)} = .884$, $p>.05$, and no significant difference occurs. However, when the sub-factors discussed separately are examined, it is again revealed that no statistically significant difference was found.

The seventh sub-problem of the research aims to obtain answers to the question " *Do biology teachers' technostress levels show a significant difference according to the years of ICT use? "*

Table 10 presents the results of the one-way ANOVA conducted to examine whether biology teachers' technostress levels differ significantly according to their years of ICT use. The findings indicate that there are no statistically significant differences across ICT use experience groups in the learning–teaching process–oriented (F1) technostress dimension, $F_{(3, 95)} = 1.73$, $p = .17$, nor in the profession-oriented (F2) dimension, $F_{(3, 95)} = 1.49$, $p = .22$. Similarly, no significant difference was found for the social-oriented (F5) technostress dimension, $F_{(3, 95)} = 1.99$, $p = .12$. In contrast, statistically significant differences emerged in the technical issue–oriented (F3) technostress dimension, $F_{(3, 95)} = 4.21$, $p = .01$, with a moderate effect size ($\eta^2 = .11$). Post hoc comparisons revealed that teachers with 1–5 years and 6–10 years of ICT use experience reported significantly higher technostress levels than those with 11–15 years of ICT use. Similarly, a significant difference was observed in the personal-oriented (F4) technostress dimension, $F_{(3, 95)} = 4.68$, $p = .01$, also with a moderate effect size ($\eta^2 = .12$). The results indicated that teachers with 6–10 years of ICT experience experienced significantly higher personal-oriented technostress compared to those with 11–15 years and 16

years and above of ICT use. Regarding the overall technostress level, the ANOVA results demonstrated a statistically significant difference among groups based on years of ICT use, $F_{(3, 95)} = 3.43$, $p = .02$, with a small-to-moderate effect size ($\eta^2 = .09$). Post hoc analyses showed that teachers with 6–10 years of ICT experience had significantly higher overall technostress levels than those with 11–15 years of ICT use. Overall, these findings suggest that technostress among biology teachers varies depending on their ICT use experience, particularly in the technical and personal dimensions, with teachers at early to mid stages of ICT use reporting higher levels of technostress compared to more experienced ICT users.

**Table 10.** *ANOVA Results on Technostress Levels of Biology Teachers By Years of ICT Use*

| Factors | Source of Variance | Sum of Squares | df | Mean Square | F | p | Difference | $\eta^2$ |
|---|---|---|---|---|---|---|---|---|
| F1 | Between Groups | 2.759 | 3 | 0.92 | 1.73 | 0.17 | | |
| | Within Groups | 50.510 | 95 | 0.53 | | | | |
| | Total | 53.269 | 98 | | | | | |
| F2 | Between Groups | 2.536 | 3 | 0.84 | 1.49 | 0.22 | | |
| | Within Groups | 53.923 | 95 | 0.57 | | | | |
| | Total | 56.460 | 98 | | | | | |
| F3 | Between Groups | 11.893 | 3 | 3.96 | 4.21 | 0.01 | 1 > 3, 2 > 3 | 0.11 |
| | Within Groups | 89.349 | 95 | 0.94 | | | | |
| | Total | 101.242 | 98 | | | | | |
| F4 | Between Groups | 9.439 | 3 | 3.15 | 4.68 | 0.01 | 2 > 3, 2 > 4 | 0.12 |
| | Within Groups | 63.885 | 95 | 0.67 | | | | |
| | Total | 73.324 | 98 | | | | | |
| F5 | Between Groups | 4.726 | 3 | 1.57 | 1.99 | 0.12 | | |
| | Within Groups | 7.331 | 95 | 0.79 | | | | |
| | Total | 80.057 | 98 | | | | | |
| Technostress Level (Overall) | Between Groups | 4.313 | 3 | 1.44 | 3.43 | 0.02 | 2 > 3 | 0.09 |
| | Within Groups | 39.806 | 95 | 0.42 | | | | |
| | Total | 44.119 | 98 | | | | | |

1: 1-5 years 2: 6-10 years 3: 11-15 years 4: 16 years and above

The eighth sub-problem of the research aims to obtain answers to the question, " *Do biology teachers' technostress levels show a significant difference according to the daily ICT usage for educational purposes? "*

Table 11 shows significant differences in technostress levels according to the daily ICT usage for educational purposes. Differences were observed in the technical issue oriented ($F_{(3-95)} = 7.084$, $p < .05$), personal oriented ($F_{(3-95)} = 3.038$, $p < .05$), and social oriented ($F_{(3-95)} = 5.227$, $p < .05$) sub-factors, as well as in the overall mean ($F_{(3-95)} = 4.930$, $p < .05$). The findings indicate that longer ICT usage for educational purposes corresponds to higher technostress levels, particularly in the technical issue, personal, and social oriented sub-factors. The effect sizes were moderate for technical issue oriented, social oriented factors and the overall mean ($0.06 \leq \eta^2 < 0.14$), while the effect size for personal oriented factor was large ($\eta^2 \geq 0.14$).

**Table 11.** *ANOVA Results on Technostress Levels of Biology Teachers By Daily ICT Usage for Educational Purposes*

| Factors | Source of Variance | Sum of Squares | df | Mean Square | F | p | Difference | $\eta^2$ |
|---|---|---|---|---|---|---|---|---|
| F1 | Between Groups | 1.827 | 3 | 0.61 | 1.12 | 0.34 | | |
| | Within Groups | 51.442 | 95 | 0.54 | | | | |
| | Total | 53.269 | 98 | | | | | |
| F2 | Between Groups | 3.748 | 3 | 1.25 | 2.25 | 0.09 | | |
| | Within Groups | 52.711 | 95 | 0.55 | | | | |
| | Total | 56.460 | 98 | | | | | |
| F3 | Between Groups | 18.509 | 3 | 6.17 | 7.09 | 0.00 | 2 > 1, 3 > 1 | 0.18 |
| | Within Groups | 82.734 | 95 | 0.87 | | | | |
| | Total | 101.242 | 98 | | | | | |
| F4 | Between Groups | 6.418 | 3 | 2.14 | 3.04 | 0.03 | 4 > 1 | 1.94 |
| | Within Groups | 66.907 | 95 | 0.70 | | | | |
| | Total | 73.324 | 98 | | | | | |
| F5 | Between Groups | 11.343 | 3 | 3.78 | 5.22 | 0.01 | 2 > 1, 4 > 1 | 0.14 |
| | Within Groups | 68.714 | 95 | 0.72 | | | | |
| | Total | 80.057 | 98 | | | | | |
| Technostress Level (Overall) | Between Groups | 5.944 | 3 | 1.98 | 4.93 | 0.01 | 2 > 1, 4 > 1 | 0.13 |
| | Within Groups | 38.175 | 95 | 0.40 | | | | |
| | Total | 44.119 | 98 | | | | | |

1: Less than 1 hour 2: Between 1 and 2 hours 3: Between 3 and 4 hours 4: 5 hours and above

## DISCUSSION AND CONCLUSION

In this study, the technostress levels of biology teachers were determined and examined in relation to various variables (gender, age, educational level, seniority, weekly teaching hours, duration of ICT use, and duration of ICT use for educational purposes).

The findings revealed that teachers generally experienced a moderate level of technostress. Similarly, studies conducted in different countries also indicate that teachers usually experience a moderate level of technostress (Çoklar et al., 2016; Efilti & Çoklar, 2019; Khlaif et al., 2022; Soy, 2023; Wang & Li, 2019; Wang et al., 2023). This result suggests that while teachers strive to use technology effectively in educational processes, they occasionally encounter challenges; however, these challenges are not at a critical level. In other words, although teachers are willing to use technology for pedagogical purposes, adapting technically and psychologically to rapidly changing digital environments remains a significant necessity.

The study found that the biology teachers reported the highest level of technostress in technical issue oriented and the lowest level in profession oriented aspects. This finding indicates that the constant renewal of technological tools and software causes concerns about technical competence among teachers; however, they appear to possess a certain level of confidence in integrating technology into their lessons professionally. It has been reported that one of the main factors increasing technostress among educators is the lack of skills in using technological devices and in coping with technical problems (Al-Fudail &Mellar,2008). Similarly, Tarafdar et al. (2011) and Ayyagari et al. (2011) emphasized that technical complexity is a major determinant of technostress.

According to gender-based analyses, there was no significant difference in technostress levels between female and male teachers. This finding is consistent with the studies of Tunç (2022) and Menzi, Çalışkan, and Çetin (2012). It can be stated that the use of technology in teaching is a challenge independent of gender and technostress is more closely related to individual competencies and attitudes.

Likewise, no significant difference was found between teachers with undergraduate and graduate degrees. This indicates that even as educational level increases, technostress does not necessarily decrease, and that the rapid pace of technological innovation may cause similar levels of stress regardless of education level.

The findings related to the age variable showed that technostress levels were similar across age groups. Although younger teachers may be more familiar with technological systems, they may occasionally struggle with the complexity of new software and hardware. In contrast, experienced teachers may benefit from professional experience as a balancing factor. Similar results were also found by Krishnan (2017), Tunç (2022), and Wang et al. (2008), indicating that there was no significant difference according to age.

A significant difference was observed according to teaching seniority; teachers with 1–5 years of experience showed higher levels of technostress than those with 11–15 years of experience. This suggests that teachers who are new to the profession may experience more stress during the process of adapting to technological innovations. Al-Fudail and Mellar (2008) also stated that teachers' skills in using technology in their lessons develop with experience, and more stress is experienced at the beginning of this process. Similar results were also reported by Kıncı (2021).

With regard to the years of ICT use, significant differences were found in the technical issue oriented and personal oriented sub-factors. Teachers with 1–5 years and 6–10 years of ICT experience had higher levels of technostress compared to those with 11–15 years and 16 years or more of experience. This suggests that having established technology use habits plays a facilitating role in coping with stress. Hsiao (2017) and Krishnan (2017) also found that as individuals' knowledge of technology increased, technostress levels gradually decreased.

In terms of the daily ICT use for educational purposes, significant differences were observed in the technical issue oriented, personal oriented and social oriented sub-factors. Teachers who used technology for educational purposes for one hour or less per day had lower levels of technostress, suggesting that excessive daily technology use may increase technostress.

This study makes an important contribution to the literature by revealing the technostress levels experienced by biology teachers while integrating technology into teaching processes. Biology is a discipline closely related to technology, involving laboratory activities, digital simulations, virtual experiments, and extensive use of audiovisual materials (Çömlekçioğlu & Bayraktaroğlu, 2001). Therefore, the technostress experienced by biology teachers is not only an individual issue but also a factor that can affect the quality of learning environments and students' scientific process skills. The findings showed that teachers experience a moderate level of technostress, suggesting that they have achieved a certain level of adaptation to technological innovations but still need further support. This result is particularly valuable as it highlights that the nature of biology education, which requires high digital competence, may impose additional pressure on teachers. Accordingly, designing continuous professional development programs for biology teachers that strengthen technological competence, pedagogical adaptation, and psychological resilience simultaneously would improve teaching quality and reduce the negative effects of technostress.

### Limitations

Despite its contributions, this study has several limitations that should be acknowledged. First, the sample size was limited to 99 biology teachers, which may restrict the generalizability of the findings. Second, the study was conducted in a single province in southeastern Türkiye, and therefore the results may not fully represent biology teachers working in different regions or educational contexts. Third, the data were collected using self-report instruments, which may be subject to social desirability bias and participants' subjective perceptions. Bu bulgular ışığında, çeşitli öneriler sunulabilir. İlk olarak, öğretmenlerin dijital yetkinliklerini geliştirmeyi amaçlayan sürekli mesleki gelişim programları, teknolojik gelişmeler doğrultusunda sistematik olarak tasarlanmalı ve düzenli olarak güncellenmelidir. Ayrıca, öğretmenlerin

günlük uygulamalarında karşılaştıkları teknik sorunlara zamanında ve etkili çözümler sağlamak için okullardaki teknik destek birimleri güçlendirilmelidir. Dahası, öğretmenlerin teknostresle daha etkili bir şekilde başa çıkmalarına yardımcı olmak için teknoloji kullanımına bağlı stres yönetimi ve psikolojik dayanıklılığa odaklanan eğitim programları sağlanmalıdır. Son olarak, gelecekteki araştırmalar, teknostres düzeylerinin disiplinler arasında farklılık gösterip göstermediğini incelemek için farklı branşlardan öğretmenleri de dahil ederek bu araştırma alanını genişletmelidir.

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