Revista Iberoamericana para la Investigación y el Desarrollo Educativo
ISSN 2007 - 7467

https://doi.org/10.23913/ride.v15i30.2369

Scientific articles

Diferencias contextuales en el tecnoestrés de estudiantes de preparatorias públicas y privadas en Ciudad del Carmen, Campeche, México

Contextual Differences in Technostress among Public and Private High School Students in Ciudad del Carmen, Campeche, Mexico

Diferenças contextuais no tecnoestresse de estudantes de escolas preparatórias públicas e privadas em Ciudad del Carmen, Campeche, México

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Revista Iberoamericana para la Investigación y el Desarrollo Educativo
ISSN 2007 - 7467

Resumen

El avance de las Tecnologías de la Información y Comunicación (TIC) ha transformado la educación. Sin embargo, ha generado el fenómeno del tecnoestrés, caracterizado por ansiedad y agotamiento ante el uso excesivo de herramientas digitales. Este estudio analizó las diferencias en los niveles de tecnoestrés entre estudiantes de nivel medio superior de instituciones públicas y privadas de Ciudad del Carmen, Campeche, mediante un enfoque cuantitativo y un diseño comparativo transversal. Los resultados evidenciaron que los estudiantes del sector público muestran una actitud más positiva hacia las TIC, mientras que los del sector privado utilizan más las redes sociales con fines académicos. Aunque no se hallaron diferencias significativas en el nivel general de tecnoestrés, se sugiere que factores individuales, como las habilidades digitales y las estrategias de afrontamiento (es decir, los recursos o mecanismos psicológicos que las personas emplean para manejar situaciones estresantes), podrían tener mayor influencia que el tipo de institución. Por lo tanto, se recomienda la implementación de programas de capacitación en competencias digitales y apoyo psicoemocional para mitigar sus efectos y mejorar la experiencia educativa de los estudiantes.

Palabras clave: tecnoestrés, TIC, educación, estudiantes, instituciones públicas, instituciones privadas.

Abstract

The advancement of Information and Communication Technologies (ICT) has transformed education. However, it has generated the phenomenon of technostress, characterized by anxiety and exhaustion due excessive use of digital tools. This study analyzed the difference in the levels of technostress among high school students from public and private institutions in Ciudad del Carmen, Campeche, using a quantitative approach and a cross-sectional comparative design. Results showed that students in the public sector show a more positive attitudes toward ICTs, while those in private sector use social networks more for academic purposes. Although no significant differences were found in the overall level of technostress, it is suggested that individual factors, such as digital skills and coping strategies (i.e., the psychological resources or mechanisms that people use to manage stressful situations), could have a greater influence than the type of institution. Therefore, the implementation of training programs in digital skills and psychoemotional support is recommended to mitigate their effects and improve the educational experience of students.

Revista Iberoamericana para la Investigación y el Desarrollo Educativo
ISSN 2007 - 7467

Keywords: technostress, ICT, education, students, public institutions, private institutions.

Resumo

O avanço das Tecnologias de Informação e Comunicação (TIC) transformou a educação. No entanto, gerou o fenômeno do tecnoestresse, caracterizado pela ansiedade e exaustão decorrentes do uso excessivo de ferramentas digitais. Este estudo analisou as diferenças nos níveis de tecnoestresse entre alunos do ensino médio de instituições públicas e privadas em Ciudad del Carmen, Campeche, usando uma abordagem quantitativa e um desenho comparativo transversal. Os resultados mostraram que os alunos do setor público têm uma atitude mais positiva em relação às TICs, enquanto os do setor privado usam mais as redes sociais para fins acadêmicos. Embora não tenham sido encontradas diferenças significativas no nível geral de tecnoestresse, sugere-se que fatores individuais, como habilidades digitais e estratégias de enfrentamento (ou seja, os recursos ou mecanismos psicológicos que as pessoas usam para gerenciar situações estressantes), podem ter maior influência do que o tipo de instituição. Portanto, recomenda-se a implementação de programas de treinamento em habilidades digitais e apoio psicoemocional para atenuar seus efeitos e melhorar a experiência educacional dos alunos.

Palavras-chave: tecnoestresse, TIC, educação, estudantes, instituições públicas, instituições privadas.

Reception Date: December 2024 **Acceptance Date:** April 2025

Introduction

The advancement of information and communication technologies (ICTs) has significantly changed educational environments, offering tools that improve access to information and promoting new teaching and learning dynamics. However, the intensive use of ICTs can generate technostress, a phenomenon characterized by stress and anxiety. These manifest themselves through symptoms of exhaustion and frustration, associated with the constant use of technological devices in students who depend on ICTs for their daily school activities (Sharma and Gupta, 2022; Qi , 2019; Upadhyaya and Acharya , 2020).

In this context, the COVID-19 lockdown intensified technological dependence in the educational system, especially among students, who increased their use of ICTs for their academic activities. As a result, technostress became a relevant problem during this period (Atlatenco and Hernández, 2022). Previous studies indicate that the combination of excessive

use of ICTs, information overload, and a lack of skills to manage these tools increased levels of anxiety and procrastination in students and teachers (Domínguez-Torres *et al* ., 2021; Morales-Mota *et al* ., 2021; Benavides Lara *et al* ., 2022). In particular, Morales-Mota *et al* . (2021) highlight that high school students (NMS) were highly vulnerable, facing difficulties balancing academic and personal demands in a completely digital environment.

On the other hand, Navarrete- Cazales (2023) analyzed research carried out between 2012 and 2021 on educational policies for the integration of ICTs in the Mexican educational system and highlights that, although policies have been implemented to incorporate technologies in education, inequalities persist in their access and use, especially in public institutions. Students in these institutions face significant technological limitations, which leads them to consider ICTs as essential tools to overcome these barriers and access better educational opportunities.

According to Cuervo *et al.* (2018), technostress can be influenced by both individual and contextual factors, highlighting that this phenomenon is not only determined by exposure to technology, but also by a complex interaction between individual factors (such as technological skills and personal perception) and contextual factors (such as the available infrastructure and the technological demands of the environment).

In this sense, structural differences between Mexican institutions, both public and private, could influence the perception and impact of ICTs use among students. Factors such as technological infrastructure and teacher training, play a key role in this process (Sánchez-Macías *et al.*, 2021). While private schools tend to have more advanced technological resources and better teacher training programs, which facilitates more effective use of ICTs, in public institutions, limitations in infrastructure and internet access increase frustration and levels of technostress among their students (Morales-Mota *et al.*, 2021).

Therefore, this study analyzes and compares the levels of technostress and experiences related to ICT use among 1,585 public and private high school students in Ciudad del Carmen, Campeche, considering four key dimensions: attitude toward ICTs, school stress, and the effects of ICT use and social media on education. Based on this, the study seeks to identify the factors that contribute to technostress in both contexts, with the goal of proposing strategies to mitigate it and improve the educational experience of high school students in Mexico.

Technostress has become more relevant in educational contexts, especially as a result of the COVID-19 pandemic. This phenomenon, which manifests as exhaustion, anxiety, and frustration, has increased due to the intensive use of technological tools and the information overload generated by them (Arredondo- Hidalgo and Caldera-González, 2022; González-López *et al*., 2021). In this sense, Atlatenco and Hernández (2022) pointed out that in Mexico the health emergency highlighted the lack of technological preparation and inequalities in the access to digital resources, which intensified the levels of technostress in students at all educational levels.

Several studies have addressed the impact of technostress on the student population, highlighting its relationship with individual and contextual factors. In this regard, Arredondo-Hidalgo and Caldera-González (2022) emphasize that digital skills and coping strategies play a key role in adapting to the demands of the educational environment, both internal (such as academic pressure) and external (such as the constant use of digital tools). These factors are crucial in mitigating stress related to the use of ICTs, since students with limited technological skills experience higher levels of technostress.

Similarly, Sánchez-Macías *et al.* (2021) identified a significant relationship between ICT addiction and academic stress. The latter is understood as a psychological and emotional response derived from the perceived demands of the educational environment, especially when students feel they lack the resources or skills necessary to cope with them. As a result, their personal well-being and academic performance are affected, which highlights the need to evaluate this phenomenon using reliable instruments.

In the international context, Cuervo *et al.* (2018) conducted a review of scientific literature indexed in the *Web of Science* about the impact of technostress on individuals and organizations. Their analysis highlights that this phenomenon is determined not only by exposure to technology, but also by the imbalance between technological demands and the resources available to manage them. Among the main causes identified are overload, complexity, and technological insecurity, factors particularly relevant in environments where ICTs are essential, such as education.

On the other hand, Penado *et al.* (2020) analyzed technostress in university students as a phenomenon of increasing impact in higher education, especially in highly digitalized academic environments. Their findings indicate that the manifestation of technostress varies according to students' perception of their ability to face technological challenges, highlighting the importance of strengthening their digital skills as a preventive strategy. They

also identified that technostress not only involves technical difficulties, but also the perception of information overload, technological dependence, and the constant pressure to stay up-to-date.

For his part, Qi (2019) analyzed the ambivalent impact—that is, both positive and negative—of the academic use of mobile devices on student performance. He highlighted that, while these tools can improve learning, their excessive use increases the risk of developing technostress. Among the factors that aggravate this phenomenon are technological overload, interruptions and distractions, as well as limited technological skills, which generate higher levels of frustration and anxiety in students. In this sense, his findings suggest that maintaining a balanced use of ICTs is essential to avoid negative effects on their well-being.

López-Barbosa *et al.* (2019) conducted a study to measure levels of acceptance, stress, and addiction to ICTs among higher education students, as well as to analyze the influence of social media use on educational processes. To do so, they designed a structured questionnaire that allowed them to assess key dimensions related to ICT use. The results indicated that technostress is a multifaceted phenomenon, composed of factors such as technophobia (fear of using technology), technological overload (excessive demands associated with ICT use), and technological dependence. These elements negatively affect the academic performance and emotional well-being of students, who are forced to confront a highly demanding and constantly evolving digital environment.

Atlatenco and Hernández (2022) analyzed the impact of technostress on high school students, highlighting that this group was particularly affected during the pandemic due to their high dependence on ICTs for academic activities. Using the person-environment fit model, the authors identified three determining factors in the manifestation of technostress at this educational level. These factors are: technological overload, maladjustment and technological anxiety. This highlights the need to strengthen strategies that help students more effectively manage the use of ICTs in academic settings.

On the other hand, Benavides Lara *et al.* (2022) explored how the perception of technostress varies according to the profile of educational actors, finding significant differences between students and teachers. Their study reinforces the idea that both individual and contextual factors influence how the challenges associated with the use of ICTs are experienced, suggesting the importance of adapting intervention strategies to the specific needs of each group.

As noted, technostress is a multifaceted phenomenon influenced by both individual and contextual factors, which requires the use of validated instruments for its measurement in educational contexts. In this regard, recent studies, such as those by López-Barbosa *et al.* (2019) and Sánchez-Macías *et al.* (2021), have developed tools to assess its impact in the Mexican academic field.

From this perspective, this study aims to analyze technostress among high school students in Ciudad del Carmen, Campeche, considering differences between public and private schools based on four dimensions: attitude toward ICTs, school stress, and the effects of ICT and social media use in education. This analysis seeks to identify the factors that influence the manifestation of technostress in these environments and propose strategies for its mitigation.

Method

This study was developed using a quantitative approach with a cross-sectional comparative design, since its purpose was to identify differences in technostress levels between public and private high school students at a given time point. According to Hernández-Sampieri and Mendoza (2018), the comparative design allows contrasting groups based on a variable of interest without manipulating the experimental conditions, which is appropriate when seeking to establish associations.

In this regard, two groups were considered: students from public and private institutions. Based on this design, differences in the dimensions of technostress were analyzed according to the type of educational institution.

Data collection instrument

Data collection was conducted in person at the facilities of each participating educational institution, with prior authorization from school administrators. Confidentiality and informed consent from students were guaranteed before administering the survey. The process took place during September 2024 and lasted approximately 30 minutes per student. Teacher presence was monitored during the survey to minimize response bias.

A structured questionnaire composed of two section was used. The first included 16 quantitative and qualitative sociodemographic questions designed to characterize participants in terms of age, gender, and time spent using ICTs. The second section consisted of the Technological Stress Scale, developed by López-Barbosa *et al.* (2019) and validated in the

Mexican context by Sánchez-Macías *et al.* (2021). This instrument assesses four key dimensions related to technostress:

1. Attitude towards ICT: assesses the degree of acceptance or rejection of technology.
2. School stress: measures the perception of stress derived from the use of ICT in the academic context.
3. Effects of ICT use: analyzes the presence of behaviors associated with technological addiction.
4. Social Media and ICT in Education: Evaluates the impact of social media and ICT on learning and interaction in the educational environment.

Each dimension was assessed using a Likert-type scale from 1 to 5, where 1 represents "strongly disagree" and 5 "strongly agree". For the attitude toward ICT dimension, an inverted scale was used. On this scale, lower values indicate a more positive attitude, while higher values reflect a more negative attitude. This inversion was implemented to highlight the relationship between a positive attitude and a lower level of stress associated with ICT use.

In previous studies, this questionnaire has demonstrated high reliability in educational settings. It presented acceptable values for internal consistency, measured by Cronbach's alpha coefficient, in its dimensions: attitude towards ICT ($\alpha = 0.846$), school stress ($\alpha = 0.682$), effects of ICT use ($\alpha = 0.929$), and social media in education ($\alpha = 0.916$). Likewise, regarding its validity, Table 1 presents the goodness-of-fit indices as evidence of an adequate factorial structure (Sánchez-Macías *et al.*, 2021).

Table 1of -fit indices for the instrument.

X^2 / gl	RMSEA	NFI	CFI	PNFI
2.8713	0.074	0.91	0.903	0.857

Source: Adapted from Sánchez-Macías *et al.* 2021.

For this study, the McDonald's Omega coefficient (Ω) (McDonald, 1999) was calculated to determine the instrument's internal consistency. The results provide evidence of a high level of reliability (Table 2), supporting its suitability for measuring technostress in the sample of participating students.

Table 2the internal consistency analysis of the dimensions of the technological stress scale.

Dimension	No. of items	Omega
Attitude towards ICT	20	0.854
School stress	10	0.783
Effects of the use of ICT	9	0.903
Social networks and ICT in education	19	0.905

Source: Prepared by the authors.

IBM SPSS Statistics version 25 software was used for data analysis using the following procedures:

- Descriptive analysis: means, standard deviations and frequencies were calculated to characterize the sample.
- Evaluating the normality of the data to determine whether it was appropriate to apply parametric or non-parametric tests.
- Comparison of the dimensions of technostress among students from public and private institutions.
- Calculation of the effect size (Hedges' g): to determine the magnitude of the differences found in the dimensions of technostress between the study groups.

Participant characteristics

The target population for this research consisted of high school students from Ciudad del Carmen, Campeche. Participants were selected using non-probability convenience sampling, taking into account their availability and access to the instrument.

The sample included 1,585 high school students, of which 1,108 students (69.91%) came from public schools and 477 students (30.09%) from private schools in Ciudad del Carmen, Campeche. Regarding gender distribution, in public schools, 549 students (49.59%) were registered as male, 546 students (49.32%) female, and 12 students (1.08%) as another gender, while in private schools the numbers were similar, with 228 students (47.90%) male, 241 students (50.42%) female, and eight students (1.68%) of another gender. Regarding age, the average was slightly higher in public institutions (M = 16.68 years, SD = 1.99) than in private schools (M = 15.88 years, SD = 1.08).

Results

Table 3 presents the results corresponding to the evaluated dimensions of technostress considering the type of institution. The mean scores revealed that students from both institutions maintain a positive attitude towards ICTs, with slightly higher scores in students from public schools (M = 2.87, SD = 0.60) compared to private schools (M = 2.80, SD = 0.57). Since the scale used associates lower scores with more positive attitudes and higher scores with more negative attitudes, these results suggest that, although the general attitude towards ICTs is in a neutral range, there are slight differences between the types of institutions.

Regarding school stress related to ICT use, scores reflected moderate levels in both groups (Table 3). Although slightly higher values were observed in students from private schools (M = 3.07, SD = 0.69) compared to public schools (M = 2.99, SD = 0.72), this difference was not statistically significant. To determine whether a real difference exists between the groups, inferential analyses would be necessary, as detailed below through inferential tests.

Regarding the effects associated with the use of ICTs, students reported low levels in both institutions (M < 3 on a scale of 1 to 5), suggesting that the impact of ICTs is not generally perceived as a significant problem. Finally, in the dimension of social networks and ICTs in education, students from private schools reported slightly higher use (M = 3.40, SD = 0.66) than their peers from public schools (M = 3.27, SD = 0.76).

Table 3 Mean scores and standard deviations of the dimensions related to technostress according to the type of school**.**

Dimensions	**Type of institution**	
	Public (n= 1,108)	**Private (n=477)**
	Mean (SD)	
Attitude towards ICT	2.87 (0.60)	2.80 (0.57)
School stress	2.99 (0.72)	3.07 (0.69)
Effects of the use of ICT	2.53 (0.94)	2.52 (0.96)
Social networks and ICT in education	3.27 (0.76)	3.40 (0.66)

Source: Prepared by the authors. Scores were obtained on a scale of 1 to 5. In the attitude toward ICT dimension, lower values indicate a more positive attitude, while higher values reflect a more negative attitude. *SD* = standard deviation.

In this regard, it was hypothesized that the dimensions of technostress differ significantly between students from public and private institutions. To this end, the

Kolmogorov-Smirnov test was first applied to verify the distribution of the data, the results of which showed statistical significance ($p < 0.001$), justifying the use of nonparametric statistical tests for comparisons between the two groups.

The results of the comparisons, presented in Table 4, included the Mann-Whitney U test and the effect size (Hedges' g). In the attitude towards ICT dimension, significant differences were identified ($U = 233566$, $p = 0.001$, $g = 0.118$), with a small effect size, according to Cohen's criteria, reflecting a slightly more positive attitude towards ICT in students from private institutions ($Mdn = 2.75$) compared to those from public institutions ($Mdn = 2.90$). However, in the school stress dimension, the results were not significant ($U = 250996$, $p = 0.134$, $g = -0.112$), suggesting an absence of significant differences between both groups. Likewise, the dimension effects of ICT use did not show significant differences ($U = 258343$, $p = 0.539$, $g = 0.011$), reflecting comparable perceptions in both contexts. On the contrary, in the dimension social networks and ICT in education, significant differences were observed ($U = 236538.5$, $p = 0.001$, $g = -0.178$), with a small effect indicating a slightly higher use in students from private institutions ($Mdn = 3.32$) compared to those from public institutions ($Mdn = 3.21$).

Table 4 Comparison of technostress dimensions between students from public and private institutions**.**

Dimensions	Type of institution		U	p	Hedges' g
	Public (n=1,108) Mdn (Range)	Private (n=477) Mdn (Range)			
Attitude towards ICT	2.90 (4.00)	2.75 (4.00)	233566	0.001	0.118
School stress	3.00 (4.00)	3.00 (4.00)	250996	0.134	-0.112
Effects of the use of ICT	2.56 (4.00)	2.33 (4.00)	258343	0.539	0.011
Social networks and ICT in education	3.21 (4.00)	3.32 (4.00)	236538.5	0.001	-0.178

Source: Prepared by the authors. Hedges' g = effect size. Mdn = median.

Discussion

The results of this study reveal that technostress, evaluated from the four dimensions mentioned above, is generally presented in a similar way, in students of institutions of higher education located in Ciudad del Carmen, Campeche, although there are significant differences in some specific dimensions. These findings support previous research highlighting the multifaceted nature of technostress, which is influenced by both individual and contextual factors (Cuervo *et al.*, 2018; Benavides Lara *et al.*, 2022).

The more favorable attitude toward ICT among students from public institutions could be linked to a perception of these tools as essential to compensate for structural technological limitations, as pointed out by Navarrete- Cazales (2023). This result is relevant to understanding how students in less privileged contexts may value ICT more as a means of self-improvement, which would act as a possible protective factor against technostress (Sánchez-Macías *et al.*, 2021).

It is also important to note that students from private institutions reported greater use of social media and ICTs in their educational context. These findings are consistent with those reported by Penado *et al.* (2020), who highlight those academic demands in private settings may be more demanding due to higher institutional expectations, which may be influenced by both institutional policies and available technological resources.

On the other hand, the results for the school stress dimension did not indicate significant differences between the two groups. This reinforces the findings of the authors, who emphasize that this phenomenon is determined not only by exposure to technology, but also by a complex interaction between individual factors, such as technological skills and personal perception, and contextual factors, such as available infrastructure and the technological demands of the environment.

Regarding the effects of the use of ICTs, students from both types of institutions reported low levels of negative impact, aligning with the results of Qi (2019), who highlighted that controlled use of ICTs tends to mitigate adverse effects such as technological addiction.

Finally, in the dimension of social networks and ICTs in education, a more significant use was observed in students from private institutions; this could be due to broader and more constant access to technological resources in these contexts (López-Barbosa *et al.*, 2020). This intensified use, although potentially beneficial for learning, can also intensify levels of technostress due to the pressure to stay constantly connected (Penado *et al.*, 2020).

Despite the differences in some specific dimensions, the overall results did not confirm the initial hypothesis, as no significant differences were found in key dimensions such as school stress or the effects of ICT use. This suggests that the type of institution is not a determining factor in overall technostress levels, as it appears to be more influenced by personal characteristics, such as technological self-management or perceived self-efficacy. This is consistent with previous research, which highlights the predominant role of individual factors over contextual ones in the experience of technostress.

These results confirm the need to develop specific strategies to mitigate technostress in both contexts, particularly through the promotion of digital skills and the design of emotional support programs that consider both the personal characteristics of the students and the institutional conditions in which they develop.

Conclusions

This study analyzed technostress, based on its dimensions, among high school students, considering differences between public and private schools in Ciudad del Carmen, Campeche. While the overall results were similar between both groups, there were specific differences, primarily in attitudes toward ICTs and the use of social media for educational purposes. However, the results suggest that the type of institution does not directly determine technostress. However, it does influence how students interact with ICTs.

It is also suggested that technostress could be related to individual factors, such as digital skills and coping strategies. However, to confirm this relationship, a more detailed analysis of the data and its relationship with the characteristics of the institutional environment would be necessary. This approach highlights the need to prioritize the development of technological skills and stress management in the design of educational programs, regardless of the structural differences between public and private institutions.

Consequently, technostress must be addressed through comprehensive strategies that include the development of digital skills, the improvement of technological infrastructure, and the implementation of psycho-emotional support programs for students. These actions would maximize the benefits of using ICTs in the educational environment, reducing their adverse effects and improving the academic experience at the high school level.

Finally, the results of this study invite a deeper examination of the interaction between ICT use and contextual factors, such as institutional policies and access to technological resources, in order to design effective strategies that minimize the impact of technostress and

promote a balanced and functional use of ICT in diverse educational contexts. These findings open up new lines of research on how these contextual variables can moderate or enhance the relationship between technology and academic well-being, allowing for the development of interventions more tailored to the realities of each institution.

Contributions to Future Lines of Research

The study of technostress among students at high school offers several opportunities for future research. Among these, the need to explore how specific digital competencies influence the perception and management of technostress stands out, identifying key skills whose improvement could benefit their interaction with ICTs.

It is also important to analyze the impact of emotional and psychological coping strategies on mitigating technostress, considering the differences in access to emotional and psychological support programs between the two types of institutions. This approach could contribute to the design of more personalized and effective interventions.

Furthermore, it would be essential to investigate how socioeconomic and family factors affect the levels of technostress in contexts characterized by technological limitations and limited availability of academic support. This would allow for a more comprehensive understanding of the phenomenon in different educational settings and contribute to identify strategies that not only optimize the use of ICTs, but also promote students' academic performance and emotional well-being.

Finally, it is pertinent to evaluate the role of educational policies and technological infrastructure in the generation of technostress, with the aim of identifying structural measures that promote a balanced, conscious, and functional use of ICTs in schools. This research could provide tools to improve the educational experience in high school institutions.

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