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Analyzing Student Technology Anxiety in the Context of Digital Transformation in Higher Education: The Role of Personal Characteristics and Self-Efficacy

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Abstract. *In the context of digital transformation in Higher Education, this study aims to examine the role of students' personal characteristics and self-efficacy in technology use. Although technology is considered a means to enhance teaching and learning, its use in education presents several challenges, including potential technology anxiety among students. To examine this issue, a quantitative study was conducted based on data obtained through a questionnaire administered to 318 undergraduate university students. Data were analyzed through structural equation modeling (SEM). The analysis points to several noteworthy conclusions: (1) specific individual differences, including a proactive personality and psychological capital, predict self-efficacy in the use of technology; (2) the aforementioned characteristics boost students' self-efficacy; (3) self-efficacy significantly influences technology anxiety, reducing the anxiety associated with technology use; and (4) psychological capital and a more proactive personality indirectly reduce technology anxiety by enhancing self-efficacy. Given these results, personalized interventions tailored to the specific personal characteristics of each student and designed to increase self-efficacy may help reduce students' anxiety when dealing with technology in educational contexts.*

Keywords: *digital transformation; higher education; proactive personality; psychological capital; technology anxiety; structural equation modeling.*

Análisis de la ansiedad tecnológica del estudiantado en el contexto de la transformación digital en la educación superior: El papel de las características personales y la autoeficacia

Resumen. *En el contexto de la transformación digital de la educación superior, este estudio tiene como objetivo analizar el papel de las características personales y la autoeficacia del estudiantado en el uso de la tecnología. Aunque la tecnología se considera un medio para mejorar la enseñanza y el aprendizaje, su uso educativo plantea desafíos como la posible ansiedad tecnológica entre quienes estudian, por lo que se llevó a cabo un estudio cuantitativo en el que 318 estudiantes de grado completaron un cuestionario. Los datos fueron analizados mediante modelos de ecuaciones estructurales (SEM). Los resultados sugieren que ciertas diferencias individuales, como la personalidad proactiva y el capital psicológico, predicen y potencian la autoeficacia del estudiantado, la cual influye significativamente en la reducción de la ansiedad tecnológica; asimismo, se observa que el capital psicológico y la personalidad proactiva reducen dicha ansiedad de forma indirecta al mejorar la autoeficacia. En vista de estos hallazgos, el diseño de intervenciones personalizadas y adaptadas a las características de cada persona para aumentar su autoeficacia en el uso de la tecnología puede ayudar a reducir su ansiedad al enfrentarse a dicho uso en contextos educativos.*

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Palabras clave: *transformación digital; educación superior; personalidad proactiva; capital psicológico; ansiedad tecnológica; modelos de ecuaciones estructurales.*

Introduction

The evolution of digital technologies has included significant advances in Information and Communication Technologies (ICT), which in turn have spurred a process of digital transformation that has had an impact on all sectors, including the field of education (Paños-Castro et al., 2024; Timotheou et al., 2023). Thanks to digital transformation, both students and instructors are able to take advantage of technology to enhance their teaching and learning (Cohen et al., 2022; Fernández-Batanero et al., 2021; Lai & Bower, 2019). This transformation has also led to the implementation of a variety of active learning tools (Bond et al., 2020; Dunn & Kennedy, 2019; Petchamé et al., 2024). However, a number of challenges remain with regard to the role of ICT in education.

Digital wellbeing can be defined as "the impact of digital technologies on what it means to live a life that is good for a human being" (Burr et al., 2020, p. 2313). In fact, "every technology can deliberately or inadvertently impact psychological wellbeing" (Peters et al., 2018, p.1). Hence, despite potential advantages, the growing use of digital technologies in higher education can also pose a range of challenges to students (Chugh et al., 2023; Haleem et al., 2022; Rapanta et al., 2021). In today's digital society, technology-enhanced teaching and learning applications and methodologies require students to develop ICT skills, and students' self-efficacy in digital media is often a prerequisite for this (Hammer et al., 2021). In fact, students' self-efficacy has been shown to play a key role in their degree of willingness or unwillingness to use digital technologies (Dutta et al., 2021). Meanwhile, previous studies of university instructors and digital transformation have shown that professors' attitudes and their self-efficacy toward digital technologies are key elements influencing the adoption and use of these tools (Azanza et al., 2024; Li et al., 2019). Conversely, a number of studies have shown that technology anxiety acts as a barrier to the effective use of technology (Awofala et al., 2019; Celik & Yesilyurt, 2013). In the context of education more specifically, technology anxiety may have negative implications for academic performance and engagement (Honicke & Broadbent, 2016; Upadhyaya & Vrinda, 2021). Therefore, it is important to understand the role of individual differences, including psychological capital and proactive personality, in shaping students' self-efficacy and their ability to use technology effectively.

The aim of this study is to examine the direct and indirect relationships between psychological capital, proactive personality, self-efficacy in technology use and technology anxiety. Specifically, this study seeks to analyze the extent to which psychological capital and proactive personality are associated with higher levels of self-efficacy in the use of technology. It also aims to investigate whether self-efficacy in technology use is related to lower levels of technology anxiety. Furthermore, the study examines the direct relationships between psychological capital and technology anxiety, as well as between proactive personality traits and technology anxiety. Finally, this research explores whether self-efficacy in technology use acts as a mediating mechanism in the relationships between psychological capital and technology anxiety, and between proactive personality and technology anxiety. By addressing these objectives, the study is intended to generate evidence that may inform the design of interventions aimed at strengthening students' technological self-efficacy and reducing technology-related anxiety in digitally enriched educational environments.

Students' individual characteristics and self-efficacy in the use of technology

Understanding the impact of the use of technology on students' wellbeing requires an examination of their individual characteristics and beliefs. As posited in Peters et al. (2018, p.12), "the impact of a technology on the psychological experience and wellbeing of an individual can be better understood, empirically evaluated, and designed for, by targeting basic psychological needs as defined by Self-Determination Theory." A grasp of these basic psychological needs (autonomy, competence, and relatedness) is necessary to understand intrinsic motivation and engagement (Deci & Ryan, 2000). Specifically, among these needs, competence fulfillment fosters a greater sense of self-efficacy (Ryan & Deci, 2017).

Self-efficacy can be defined as the "belief in one's capability to organize and execute courses of action required to produce given attainments" (Bandura, 1997, p.3). In the educational context, several studies have shown a positive effect of self-efficacy on students' academic performance (Greco et al., 2022; Honicke & Broadbent, 2016). Narrowing the focus to the use of technology in education, technology self-efficacy refers to the degree to which students believe they can successfully operate technological and digital media (Hammer et al., 2021). Research shows that both people's objective skills and their subjective beliefs about their own competence impact how they adapt to, react to and use digital technologies (Peiffer et al., 2020). To be more specific, one´s self-esteem with regard to the effective future use of technological and digital media is a predictor of successful use of these tools (Ulfert-Blank & Schmidt, 2022). Individuals with high technological and digital self-efficacy are less likely to develop technological anxiety (Upadhyaya & Vrinda, 2021), and they tend to be more open and willing to use digital devices and applications (Venkatesh & Bala, 2008), and they generally perceive these tools as easier to use and express a greater intention to do so (Hsia et al., 2012).

Among the range of individual resources that people call upon, psychological capital (PsyCap) is one of the most closely related to self-efficacy. Indeed, self-efficacy itself is considered one of the components of the former

construct. Psychological capital can be defined as "an individual's positive psychological state of development and is characterized by: (1) having confidence (self-efficacy) to take on and put in the necessary effort to succeed at challenging tasks; (2) making a positive attribution (optimism) about succeeding now and in the future; (3) persevering toward goals and, when necessary, redirecting paths to goals (hope) in order to succeed; and (4) when beset by problems and adversity, sustaining and bouncing back and even beyond (resilience) to attain success" (Luthans et al., 2007b, p.3). The construct of psychological capital, then, is said to include four different dimensions: (1) hope; (2) confidence, self-efficacy; (3) resilience; and (4) optimism (Luthans et al., 2004; Luthans et al., 2007a). Among the possible effects of positive psychological capital are improvements in individuals' performance and wellbeing (Luthans & Broad, 2022). Research on PsyCap and technology use has shown that PsyCap can help determine e-learning success and academic achievement (Khoshaim, 2024). The construct has also been found to be positively associated with on e-learning satisfaction (Stracke et al., 2022) and online distance learning students' engagement, as well as decreasing the likelihood of burnout (Barratt & Duran, 2021). Therefore, the following hypothesis is formulated:

H1: Psychological capital is positively associated with self-efficacy in the use of technology.

Regarding personality traits, individuals with a proactive personality are those who "identify opportunities and act on them; they show initiative, take action, and persevere until they bring about meaningful change" (Crant, 1996, p.43). Previous studies have found that a more proactive personality positively influences student engagement, an effect that is mediated by instructor-student relationships and student self-efficacy (Chen et al., 2021). This personality trait is also positively associated with online learning performance (Chai et al., 2023). During the COVID-19 pandemic, students with a proactive personality demonstrated a higher quality of online interactions and greater internet self-efficacy (Zheng et al., 2020). In turn, students with higher levels of self-efficacy showed better academic outcomes (Alemany-Arrebola et al., 2020; Talsma et al., 2021). Therefore, a positive relationship is expected between proactive personality and self-efficacy in the use of technology, giving rise to the following hypothesis:

H2: Proactive personality is positively associated with self-efficacy in technology use.

Self-efficacy and technology anxiety

Bandura's self-efficacy theory (1997) states that an individual's belief in their ability to perform in particular contexts or to complete a task may significantly affect their behavior and emotions. Consequently, higher levels of self-efficacy may result in lower anxiety levels, as individuals perceive themselves as more competent and confident in their ability to use technology effectively. Technology anxiety can be defined as "the tension from the anticipation of a negative outcome related to the use of technology deriving from experiential, behavioral, and physiological elements" (Wilson et al., 2023, p.186).

Previous studies have shown that this anxiety influences the perceived ease of use of technology (Fakun, 2009; Saadé & Kira, 2007), as well as satisfaction with and the intention to use technology (Meuter et al., 2003). Recently, during the COVID-19 pandemic, instructors with low technology anxiety showed a higher level of e-learning system usage, showing a direct effect of self-efficacy on actual use (Alkhawaja et al., 2021). Similarly, technology anxiety has been found to negatively impact the acceptance and usage intentions of new technologies, such as virtual learning environments, especially when individuals perceive technology as a threat, leading to reduced adoption intentions (Gunasinghe & Nanayakkara, 2021).

Recent studies of university students have found that technology anxiety and computer self-efficacy are negatively correlated (e.g., Iraola-Real et al., 2023; Meinhardt-Injac & Skowronec, 2022). In other words, lower anxiety levels are associated with higher self-efficacy, indicating that people who feel more capable of utilizing technology also have lower anxiety levels. Therefore, the following hypothesis is formulated:

H3: Self-efficacy in the use of technology is negatively associated with technology anxiety.

Students' individual characteristics and technology anxiety

PsyCap is considered a positive psychological resource that can help individuals manage stress by promoting positive coping strategies (Gupta et al., 2019; Moreno-Montero et al., 2024). Research indicates that PsyCap plays a protective role against stress and burnout, especially in high-stress environments such as education and healthcare (Yao et al., 2022; Zhang et al., 2019). In this regard, PsyCap has been found to be negatively associated with anxiety (Magwegwe & Sithole, 2024). Therefore, higher levels of psychological capital may mitigate the adverse effects of anxiety, suggesting that individuals with greater psychological resources are less likely to experience anxiety.

Furthermore, PsyCap may act as a mediator in the relationship between stressors and anxiety. For instance, in the context of academic stress among college students during the COVID-19 pandemic, PsyCap was found to partially mediate the relationship between academic stress and anxiety, suggesting that higher psychological capital may reduce the impact of stress on anxiety levels (Yang & Yang, 2022).

In the technological context, PsyCap has also been found to mediate the relationship between problematic social media usage and anxiety (Jiang, 2021). Students with higher degrees of psychological capital were likely to experience less anxiety even if they engaged in problematic social media usage.

Given these relationships, we expect that psychological capital will be negatively related to technology anxiety, as expressed in the following hypothesis:

H4: Psychological capital is negatively associated with technology anxiety.

A proactive personality is one of the individual characteristics that is particularly relevant when it comes to coping with anxiety, as it influences how individuals anticipate and manage stressors (e.g., Park & DeFrank, 2018; Yi-Feng et al., 2021). Proactive coping strategies, characterized by planning and preventive actions, have been associated with lower anxiety levels (e.g., Griva & Anagnostopoulos, 2010; Serrano et al., 2021). These strategies are part of the broader proactive personality trait, which helps individuals manage stress and anxiety more effectively (Li & Miller, 2017; Pearman et al., 2021; Serrano et al., 2021). With respect to the use of technology, having a proactive personality was found to be negatively related to the technology-induced stress (also called technostress) (Pirkkalainen et al., 2019). Therefore, we expect that proactive personality will also contribute to coping with technology anxiety in the educational context. Thus, the following hypothesis is formulated:

H5: Proactive personality is negatively associated with technology anxiety.

Mediating role of self-efficacy

As previously mentioned, self-efficacy has been found to serve as a protective factor against stressors and technology-related stress, reducing adverse mental health outcomes and anxiety symptoms. This protective function has been analyzed in diverse contexts, including remote work and human-computer collaboration (Consiglio et al., 2023; Schönfeld et al., 2016). Given the expected relationship between self-efficacy and psychological capital and proactive personality, we expect that self-efficacy in the use of technology will mediate the relationship between psychological capital and technology anxiety. Thus, individuals' belief in their ability to effectively use technology will influence how psychological resources and traits impact their technology-related anxiety. Hence, the following hypotheses are formulated:

H6: Self-efficacy mediates the relationship between psychological capital and technology anxiety.

H7: Self-efficacy mediates the relationship between proactive personality and technology anxiety.

Materials and Methods

Participants

The study sample consisted of 318 undergraduate students from three Spanish Universities, with a mean age of 20.93 years (SD = 2.30). The sample was made up of 66% men and 34% women. A plurality of the participants were third-year university students (n = 153), followed by second-year students (n = 64), fourth-year students (n = 51), and first-year students (n = 50). They were studying engineering (65.7%), sport sciences (18.6%) and management (9.7%).

Measures

Perceived self-efficacy in the use of digital technologies was assessed using a 5-item scale adapted from McDonald and Siegall (1992). Participants rated their agreement with statements such as, "When I have to learn a new task based on digital technologies, my first reaction is to be confident that I can do it," on a 5-point Likert scale ranging from 1 (Strongly disagree) to 5 (Strongly agree). Cronbach's alpha for this scale was .84, indicating a good degree of internal consistency.

Psychological capital was measured using the 12-item Psychological Capital Questionnaire–12 (PCQ-12), adapted and validated for academic contexts by Martínez et al. (2021). The scale includes items such as, "I feel confident in my ability to share information about my studies with others". Participants rated each statement on a 5-point Likert scale ranging from 1 (Strongly disagree) to 5 (Strongly agree). The scale assessed four dimensions: self-efficacy, hope, resilience, and optimism. Cronbach's alpha for the overall scale was .90, indicating excellent reliability.

Proactive personality was measured using a 10-item scale developed by Bateman and Crant (1993). Items included statements such as, "Wherever I have been, I have been a powerful force for constructive change". Participants responded on a 5-point Likert scale ranging from 1 (Strongly disagree) to 5 (Strongly agree). Cronbach's alpha for this scale was .85, indicating good internal consistency.

Technology anxiety was assessed using the 11-item Abbreviated Technology Anxiety Scale (ATAS) developed by Wilson et al. (2023). This scale included statements such as, "Using technology makes me nervous" and "I am inefficient with technology-" Participants rated their agreement on a 5-point Likert scale ranging from 1 (Strongly disagree) to 5 (Strongly agree). Cronbach's alpha for this scale was .94, reflecting excellent internal consistency.

Procedure

The study was conducted with a sample of Spanish undergraduate students enrolled in various academic degree programs. Participants were recruited through announcements in class and email invitations distributed by instructors in multiple departments. Students were informed about the study's goals and confidentiality protocols. All participants provided informed consent in compliance with institutional ethical guidelines. The survey was designed to collect data anonymously, including scales that were relevant for the study, resulting in an anonymized dataset by design. A questionnaire was distributed electronically through Google Forms. It included demographic questions (e.g., age, gender, academic year) and a

series of validated instruments to measure psychological capital, proactive personality, perceived self-efficacy in using digital technologies and technology anxiety. The questionnaire took approximately 15–20 minutes to complete.

Data analysis

To process the collected data, descriptive and correlational analyses were conducted. Structural Equation Modeling (SEM) was used to test the hypothesized model shown in Figure 1. The software used for the analysis was IBM SPSS Amos 28.

Results

Descriptive statistics, including means, standard deviations, and correlations for the study variables, are presented in Table 1. Psychological capital (M = 3.65, SD = .74) was significantly and positively correlated with proactive personality (r = .51, p < .01) and with self-efficacy in the use of digital technologies (r = .45, p < .01). Similarly, proactive personality (M = 3.54, SD = .79) was also positively correlated with self-efficacy (r = .37, p < .01). On the other hand, technology anxiety (M = 1.73, SD = .84) was negatively correlated with self-efficacy (r = -.33, p < .01), but this variable was not significantly correlated with psychological capital (r = -.10, p > .05) or proactive personality (r = -.03, p > .05).

SEM was used to examine the effects of proactive personality and psychological capital on self-efficacy in technology use and technology anxiety, with self-efficacy hypothesized to mediate the relationship between proactive personality and psychological capital and technology anxiety (Figure 2). The model fit indices suggested a moderately acceptable fit to the data:

Table 1. Means, Standard Deviations, and Correlations

Variable	M	SD	1	2	3	4
1. Psychological capital	3.65	.74	—			
2. Proactive personality	3.54	.79	.51**	—		
3. Self-efficacy in the use of digital technologies	3.87	.77	.45**	.37**	—	
4. Technology anxiety	1.73	.84	-.10	-.03	-.33**	—

* p < .05; ** p < .01

χ^2 (480) = 941.66, p < .001, RMSEA = .054 (90% CI [.048, .060]), and CFI = .935.

Psychological capital was significantly and positively associated with self-efficacy, meaning that higher levels of psychological capital predict greater confidence in using technology, a finding that supports H1 (β = .42, SE = .07, CR = 5.10, p < .001). Similarly, proactive personality was positively associated with self-efficacy, supporting H2, though the effect here was smaller (β = .17, SE = .06, CR = 2.43, p = .01). In turn, self-efficacy was found to significantly reduce technology anxiety, exerting a negative direct effect, a result that supports H3 (β = -.43, SE = .11, CR = -4.99, p < .001). However, the direct effects of psychological capital (β = .02, SE = .09, CR = 0.32, p = .743) and proactive personality (β = .11, SE = .09, CR = 1.59, p = .11) on technology anxiety were not statistically significant, meaning that H4 and H5 are not confirmed.

Indirect effects were analyzed to assess the mediating effect of self-efficacy in the relationship between individual characteristics and technology anxiety. The indirect effect of psychological capital on technology anxiety as mediated by self-efficacy was significant, supporting H6 (β_indirect = -.18, p < .05). This suggests that psychological capital reduces technology anxiety

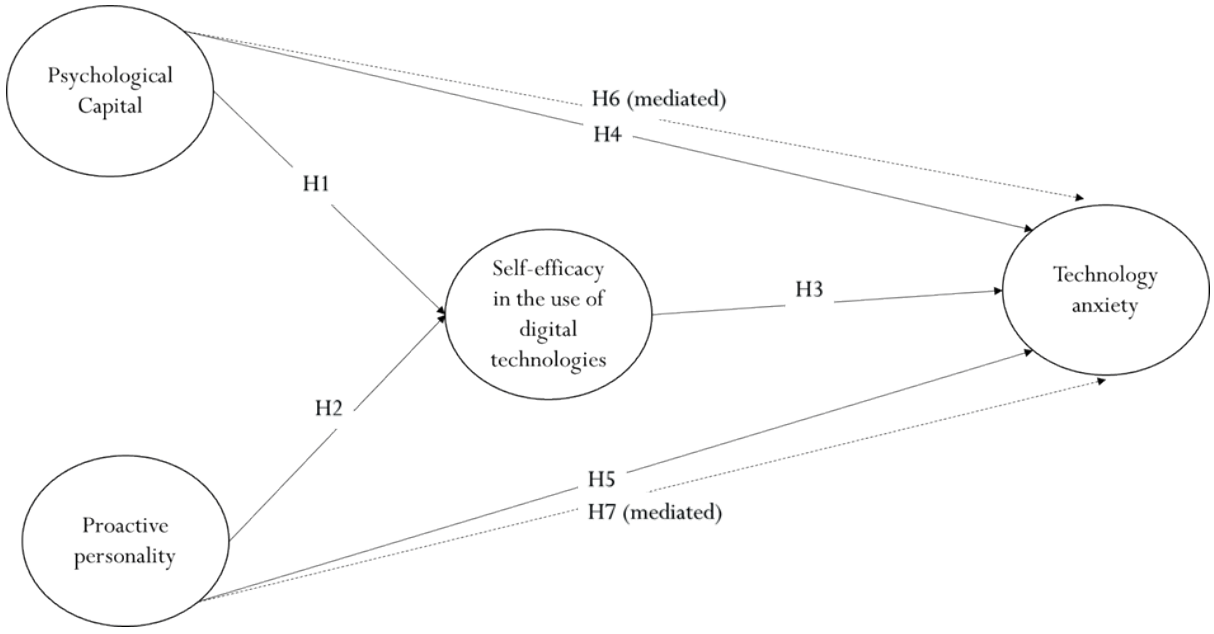

Figure 1. Research model

by enhancing self-efficacy. Similarly, the indirect effect of proactive personality on technology anxiety mediated by self-efficacy was also significant, supporting H7 (β_indirect = -.07, p < .05). These findings highlight the mediating role of self-efficacy in the relationship between individual characteristics and technology anxiety.

Discussion

The main aim of this study was to examine the direct and indirect effects of psychological capital and proactive personality on technology anxiety among university students, considering the mediating role of self-efficacy in the use of technology. The findings provide empirical support for most of the proposed hypotheses, which are discussed in detail below.

Consistent with H1, psychological capital was found to be positively associated with self-efficacy in the use of technology. This result aligns with previous studies suggesting that psychological capital enhances individuals' perceptions of their confidence and competence when facing challenges (Khoshaim, 2024; Luthans et al., 2007b). Given that self-efficacy is one of the four dimensions of psychological capital, it is not surprising that students with higher psychological resources feel more capable of handling digital technologies effectively. These findings reinforce the idea that fostering psychological capital can indirectly strengthen students' digital adaptation.

Our results also supported H2, indicating that a proactive personality was positively associated with technological self-efficacy. This finding corroborates earlier research suggesting that proactive individuals are more likely to seek out learning opportunities, overcome obstacles and develop greater confidence in their abilities (Chai et al., 2023; Chen et al., 2021). Although the magnitude of the association was smaller than the one with psychological capital, proactive students exhibited a higher degree of belief in their technological capabilities, confirming the importance of personality in digital education contexts.

With respect to H3, technological self-efficacy was significantly and negatively related to technology anxiety. Students with higher levels of confidence in their ability to use technology reported lower levels of anxiety, a finding consistent with the theoretical framework of self-efficacy theory (Bandura, 1997) and with previous empirical results (Iraola-Real et al., 2023; Upadhyaya & Vrinda, 2021). This highlights the key role of self-efficacy as a protective factor against the emotional barriers often associated with digital learning environments.

Contrary to our expectations, H4 was not supported by the data. While previous research suggests that psychological capital (PsyCap) functions as a direct buffer against general anxiety (e.g., Magwegwe & Sithole, 2024; Yang & Yang, 2022), our findings do not confirm this direct effect in the digital context. A possible explanation can be derived from social cognitive theory, which explains that behavior and emotional responses are primarily shaped by domain-specific efficacy beliefs rather than by broad dispositional resources (Bandura, 1977). PsyCap represents a higher-order psychological resource comprising hope, optimism, resilience and efficacy. However, its efficacy component is conceptualized at a generalized level. In contrast, technology anxiety is likely driven by task- and domain-specific beliefs about competence. From this perspective, PsyCap may influence anxiety only by strengthening technology-related self-efficacy, which is a more proximal cognitive me-

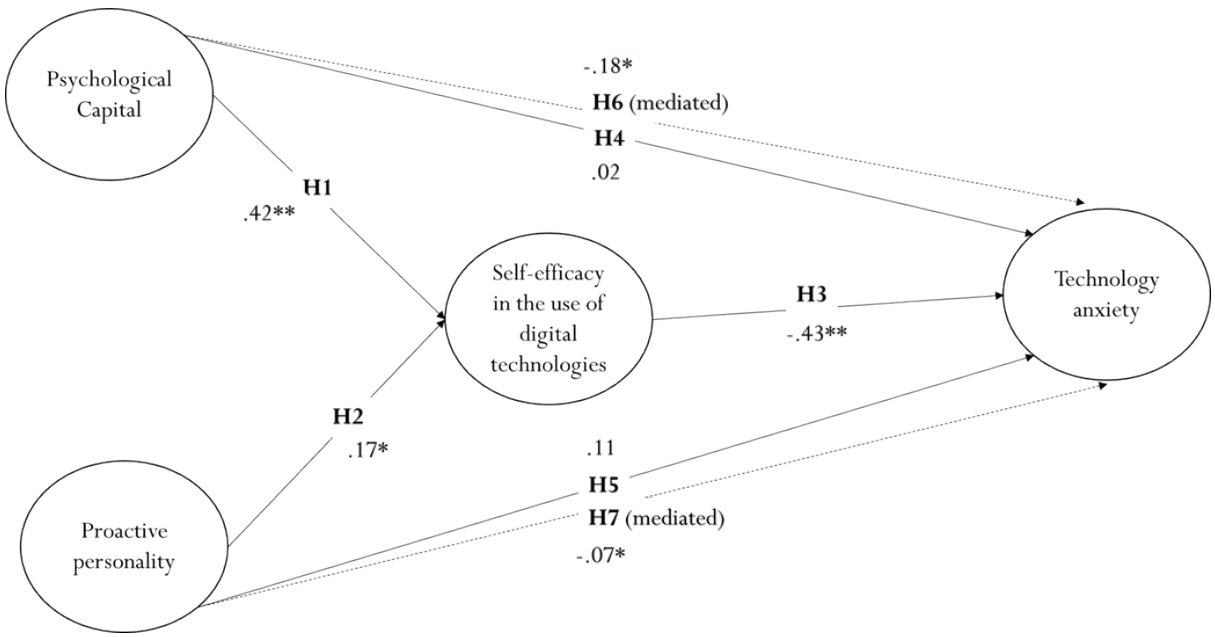

Figure 2. Structural equation model with standardized path coefficients.
Note: **p < .001; *p < .05

chanism to regulate emotional responses. Therefore, the rejection of H4 suggests that generalized psychological resources alone may be insufficient to reduce anxiety when the stressor is closely related to perceived technical ability. Similarly, H5 was not supported. Proactive personality was not directly associated with technology anxiety. While previous literature has linked proactive coping with lower levels of general stress and anxiety (Pearman et al., 2021; Pirkkalainen et al., 2019), in the specific context of digital technology use, proactive personality alone may not be sufficient to reduce anxiety unless accompanied by a strong sense of technological self-efficacy. Taken together, the rejection of the direct paths and the presence of full mediation suggest that broad personal resources may predispose students to engage with technological challenges, but domain-specific self-efficacy is the key regulator of anxiety responses. From a practical perspective, these findings suggest that educational institutions should prioritize interventions aimed at strengthening students' technology-specific self-efficacy, for example through structured digital skills training and guided practice, rather than focusing only on initiatives designed to foster general positive psychological dispositions. Although promoting psychological capital and proactive attitudes remains valuable, reducing technology anxiety in higher education may require specific strategies that directly enhance students' perceived technological self-efficacy.

The mediation analysis supported H6. In other words, self-efficacy significantly mediated the relationship between psychological capital and technology anxiety. This finding suggests that psychological capital enhances students' technological self-efficacy, which in turn reduces their technology anxiety. This pathway supports previous research emphasizing the importance of intermediary mechanisms through which personal resources influence emotional outcomes in digital contexts (Consiglio et al., 2023; Schönfeld et al., 2016).

Finally, H7 was also supported. Self-efficacy mediated the relationship between proactive personality and technology anxiety. This indicates that proactive students experience less technology anxiety primarily because their proactive traits foster greater confidence in their technological capabilities. These findings contribute to the growing body of research on the mechanisms underlying students' successful adaptation to technology-enhanced learning environments (Zheng et al., 2020).

Conclusions

This study contributes to a better understanding of the psychological mechanisms underlying technology anxiety in higher education by demonstrating the key role of technological self-efficacy. While psychological capital and proactive personality were not directly associated with reduced technology anxiety, they did exert significant indirect effects through the enhancement of self-efficacy in technology use. Thus, our findings suggest that, while psychological capital and proactive personality are important individual characteristics, their effects on technology anxiety are fully mediated by technological self-efficacy. This highlights the central role of self-efficacy in helping students cope with the demands of digital transformation in higher education. Therefore, direct interventions aimed at reducing technology anxiety may be less effective than strategies designed to enhance self-efficacy. Educators should emphasize self-efficacy building activities aimed at technology use, particularly by tailoring approaches to individual psychological resources and personality traits.

Several limitations should be acknowledged. First, the cross-sectional nature of the study limits the ability to establish causal relationships among variables. Longitudinal designs would offer a more robust understanding of how these constructs interact over time. Second, the study relied on self-reported data, which may be subject to response biases. Third, the study's sample was comprised of students from selected Spanish universities, with those in engineering programs representing 65% of the participants. This institutionally and discipline-specific composition allows for a focused examination of the relationships examined in this study within a clearly defined educational context, but it also restricts the generalizability of the findings to other academic fields, institutional environments, cultural contexts, or age groups. Consequently, future research involving a more diverse student body across various disciplines and demographics would be essential to validate these results more broadly. Finally, the instruments assessing perceived self-efficacy, proactive personality, and technology anxiety have not been formally validated for use with Spanish samples. A rigorous blind back-translation procedure was carried out to ensure linguistic equivalence, and the reliability of these measures within the current sample was supported by the observed internal consistency indices, which ranged from satisfactory to excellent. However, the absence of a complete psychometric validation in the Spanish context may limit the interpretability and cross-cultural comparability of the results.

Future research could adopt longitudinal or experimental designs to explore the causal mechanisms underlying the relationships identified. It would also be valuable to examine other potential moderators and mediators, such as digital emotional intelligence, perceived institutional support and previous success with technology use. Expanding the research to more diverse and international samples would also provide a broader understanding of how cultural and contextual factors shape students' experiences with digital transformation in higher education. By addressing these areas, future research can advance our understanding of how to support students in navigating the ongoing digital transformation of higher education effectively.

Author disclosure statement

The authors declare no conflict of interest.

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