Reducing Teachers' Techno-anxiety and Technostress through AI-TPACK

Nataliia DEMESHKANT[a*] & Sławomir TRUSZ[b]
[a]*University of the National Education Commission, Krakow, Poland*
[b]*WSB University, Dąbrowa Górnicza, Poland*
*demesznat@gmail.com

Abstract: The use of information technology in education, including AI-based tools, can lead to increased anxiety and become a significant source of technostress. One possible mitigating factor for these effects is teachers' knowledge of technology, pedagogy and content related to artificial intelligence (AI-TPACK). This hypothesis was examined in a cross-sectional correlational study involving pre-service teachers. The results showed low levels of technical anxiety and technostress and moderate levels of AI-TPACK. Techno-anxiety and technostress were strongly and positively correlated, while both were negatively associated with AI-TPACK. Moreover, AI-TPACK significantly moderated the relationship between techno-anxiety and technostress in selected configurations. In line with the assumed buffering function of AI-TPACK, the relationship between anxiety and stress was strongest among teachers with the lowest knowledge.

Keywords: Artificial Intelligence (AI), Techno-anxiety, Technostress, AI-TPACK

1. Introduction

The integration of new IT tools can trigger techno-anxiety, manifested through increased workload, job insecurity, and perceived ICT incompetence. Techno-anxiety is a fear-driven state linked to anticipated negative consequences of ICT use (Wilson et al., 2023). It is closely related to technostress, marked by uncertainty in adapting to technological demands and negatively affecting attitudes and well-being (Wang et al., 2020). Both factors significantly influence teachers' effectiveness; thus, teachers' TPACK appears to mitigate these states (Dong et al., 2019). Proposed by Mishra and Koehler (2006) the TPACK model asserts that Technological Knowledge (TK), a core aspect of teacher competence, must be integrated with Content Knowledge (CK) and Pedagogical Knowledge (PK) to enable effective ICT use in education. These complex forms of knowledge result from their interaction and include: Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), and Technological Pedagogical Knowledge (TPK). The model is also employed in studies on AI in education. TPACK in AI model includes three core components: PK, CK, and PCK, along with four AI-specific elements tied to teachers' knowledge and skills (Ning et al., 2024). The TPACK framework evolves by incorporating components that define teacher competencies related to AI use in education. The research question of this study is: to what extent does the AI TPACK framework act as a significant inhibitor of anxiety and technostress, thereby reducing the strength of the relationships between the variables under investigation?

2. Materials and Methods

The sample included pre-service teachers of Polish universities (n = 419). The mean age of participants was 30.63 (SD=8.66). Data were collected using standardized questionnaires. Techno-anxiety was measured using Abbreviated Technology Anxiety Scale (ATAS; Wilson et al., 2023). Technostress was measured using Person-Environment Fit Scale of Technostress (P-EFST; Wang et al., 2020) which captures misfit in the Abilities-Demands (ADT) and misfit in the Needs-Supplies (NST) components. Teachers' TPACK in AI was

measured using AI-TPACK Scale (Celik, 2023), which includes teachers' knowledge in five AI-related areas: AI-TK, AI-TPK, AI-TCK, AI-TPACK, and Ethics. Measurements taken with these tools were highly reliable. Cronbach's α values were: .891 (ATAS), .915 (P-EFST), .979 (AI-TPACK). Variables were described using basic descriptive statistics.

3. Results

Average levels of techno-anxiety and technostress were low (based on raw scores: 1–5 for ATAS and 0–4 for P-EFST and its components). In contrast, the average level of teachers' technological, pedagogical and content knowledge was moderate (based on raw scores: 1–7 for AI-TPACK and its components). The relationships between techno-anxiety, technostress, and teachers' TPACK in AI were assessed. Techno-anxiety was positively related to technostress (cf. Supplem. with detailed correlation analysis results, Table 1 in Harvard Dataverse, https://doi.org/10.7910/DVN/IBSN6I). As the first variable increased, the values of the second variable also increased. In contrast, correlations between techno-anxiety or technostress and AI-TPACK were negative – greater TPACK was associated with lower ICT-related emotional distress. The strength of the relationship between techno-anxiety and technostress was high (.692 to .744), while it was moderate for the associations between AI-TPACK components and techno-anxiety (-.273 to -.404) and technostress (-.328 to -.435).

Finally, a series of moderation analyses (Hayes, 2023, Model 1) was conducted to examine whether AI-TPACK (treated as a potential intervening variable) modifies the relationship between techno-anxiety (taken as a predictor) and technostress (considered as an explanatory variable related to the predictor) (cf. Fig. 1 left panel). Therefore, Model 1 allow to quantify the extent to which this relationship changes in strength or direction at specific levels of AI-TPACK (16th, 50th, and 84th percentiles). The computations were repeated for each extracted component of technostress and AI-TPACK. The number of moderation analyses required is equal to the product of the levels of variables included in the analysis. Therefore, 18 moderation analyses were performed, taking into account the product: 1 (ATAS) × 6 (AI-TPACK: total score, AI-TK, AI-TPK, AI-TCK, AI-TPACK, Ethics) × 3 (P-EFST: total score, ADT, and NST).

Figure 1 illustrates the analyses, the left panel shows the theoretical model of the assumed effects, while the right panel presents the empirical evidence supporting them.
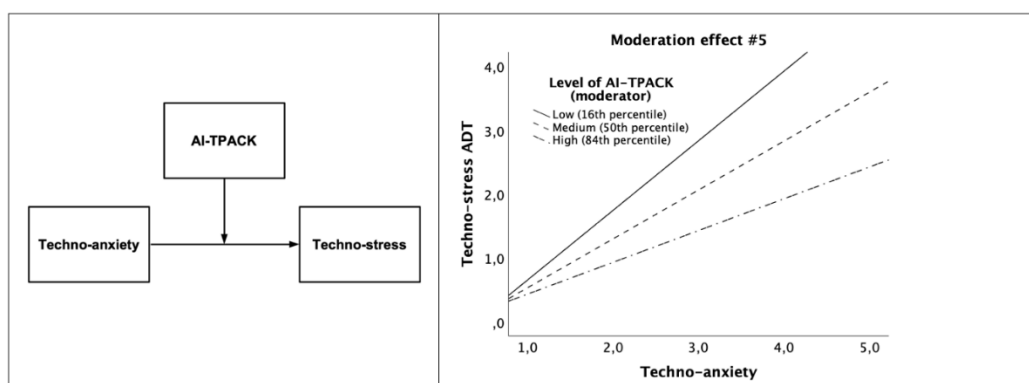

Figure 1. Moderation effects – theoretical model (left panel) and graphical evidence of significant interaction AI-TPACK with ADT (right panel).

Note. The remaining significant interactions between P-EFST (and its components) and AI-TPACK (and its components) are the same as those presented in the chart; therefore, their interpretation remains consistent with the explanations provided in the paper.

Of the 18 interaction analyses conducted, one was statistically significant, while six others approached significance (i.e., .05 < p < .10). The relationship between techno-anxiety and technostress was significantly moderated by AI-TPACK, with a negative interaction effect (β = –.187, p = .033). As the level of AI-TPACK increased, the positive relationship between techno-anxiety and ADT technostress became weaker. The effect of techno-anxiety on ADT

technostress was strongest when AI-TPACK was low (below the 16th percentile), with β = .874. As the level of the moderator increased, the strength of this relationship decreased: at the average level of AI-TPACK (50th percentile), β = .635, and at a high level (above the 84th percentile), β = .424 (cf. Fig.1 right panel).

Six additional interactions examined how the total AI-TPACK score, along with its components (AI-TK, AI-TPK, and Ethics) moderated the relationship between techno-anxiety and technostress (cf. Supplem. with detailed moderation analysis results, Table 2 in Harvard Dataverse, https://doi.org/10.7910/DVN/IBSN6I). AI-TPACK (total score and components) consistently acted as a buffer in the relationship between techno-anxiety and technostress, higher levels of the moderator weakened the impact of the predictor on the outcome.

4. Discussion and Conclusions

The results for techno-anxiety and technostress showed low average levels. Conversely, AI-TPACK level was moderate, indicating that teachers should further develop their technological, pedagogical, and content knowledge, especially considering its protective role amid rapid ICT growth. Similar results are reported by Dong et al. (2019) and Özgür (2020), who stress that TPACK plays a key role in reducing teachers' technostress. Techno-anxiety correlated strongly and positively with technostress, while rising AI-TPACK level corresponded with declines in both. Moderation analyses revealed that AI-TPACK significantly moderated the techno-anxiety-technostress link in selected cases. TPACK reduces the gap between the requirements of the environment and the AI skills possessed, allowing teachers to function more effectively in school (Algerafi et al., 2023). Frequent engagement in school settings where AI-TPACK is used to cope with technological challenges may have made this knowledge a crucial contextual factor moderating the link between techno-anxiety and technostress. It cannot be excluded that other factors, both objective and subjective, may serve as specific regulators. These factors are worth identifying in future studies considering the professional role, institutional culture, and participants' socio-cultural or academic capital.

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