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Reframing Technostress in Non-Formal Education: An AMO-Based Human Resource Management Model for Sustainable Digital Transformation

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ABSTRACT

Background. The rapid digitalization of education has intensified the integration of digital technologies into teaching and administrative processes, generating new organizational challenges related to technostress among educators. While existing studies predominantly emphasize individual psychological perspectives and coping mechanisms, a critical gap remains in understanding the organizational and human resource management (HRM) dimensions that shape technostress, particularly in non-formal education contexts, which are characterized by flexible structures and limited institutional support. Addressing this gap, this study aims to examine how technostress emerges as an organizational phenomenon and to develop an evidence-based HRM model grounded in the Ability–Motivation–Opportunity (AMO) framework to support sustainable digital transformation.

Methods. This study employed a qualitative multi-site case study design involving non-formal education institutions in Kendari City, Indonesia. Data were collected through in-depth interviews, observations, document analysis, and supporting quantitative indicators. Data analysis followed a multi-stage coding process (open, axial, and selective coding) combined with convergent mixed analysis to enhance analytical rigor and validity.

Results. The findings reveal that technostress is multidimensional, consisting of techno-overload, techno-complexity, techno-uncertainty, and techno-invasion. These dimensions are primarily shaped by organizational factors, including digital governance, institutional support systems, communication practices, and workload structures. Notably, organizational opportunity emerged as a key mediating mechanism influencing educators' adaptation and teaching effectiveness. As a novel contribution, this study develops an AMO-based HRM intervention model and operational standard operating procedures (SOPs) that systematically link organizational factors to technostress mitigation and improvements in learning performance.

Conclusion. This study concludes that technostress in non-formal education is primarily shaped by organizational conditions rather than technology alone. The findings further reveal that technostress occurs at varying levels—predominantly low to moderate—indicating that digital stress is a graded and context-dependent phenomenon rather than an extreme condition. By integrating technostress theory with the Ability–Motivation–Opportunity (AMO) framework, this study offers a

novel organizational perspective and develops practical HRM-based strategies for managing digital work environments. The results emphasize that sustainable digital transformation depends on aligning technological innovation with structured organizational support systems to enhance educator well-being and learning effectiveness.

1. INTRODUCTION

The rapid acceleration of digital transformation has fundamentally reshaped educational systems worldwide, including how human resources are managed in educational institutions. Digital platforms, learning management systems (LMS), data analytics, and artificial intelligence (AI)-based tools are increasingly integrated into teaching and administrative practices to enhance efficiency and learning outcomes (Dong et al., 2020; Liaqat et al., 2025). However, while digitalization promises improved performance and flexibility, it simultaneously introduces new psychosocial challenges for educators, particularly in the form of technostress, defined as stress experienced due to the inability to cope with technological demands and continuous digital adaptation (Tarafdar et al., 2007; Liaqat et al., 2025). Previous studies consistently demonstrate that technology-driven work environments may generate techno-overload, techno-complexity, techno-uncertainty, and techno-invasion, which potentially reduce job satisfaction, teaching effectiveness, and overall well-being among educational personnel (Salo et al., 2022; Decataldo & Fiore, 2022; Andryan & Suminar, 2024; Valiao, 2025).

Despite these advances, existing technostress literature remains conceptually limited in three critical ways. First, prior studies predominantly focus on formal education contexts such as universities and schools, emphasizing individual psychological outcomes and coping mechanisms (Sharma & Gupta, 2023; Ren et al., 2025), thereby neglecting institutional environments with fundamentally different organizational structures. Second, technostress has largely been treated as an individual-level phenomenon, with insufficient attention to organizational and human resource management (HRM) mechanisms that systematically shape its emergence and consequences. Third, most studies rely on cross-sectional designs and reactive coping perspectives, offering limited insight into proactive, organization-driven interventions that can prevent technostress before it occurs (Zhao et al., 2020; Pyle, 2023). As a result, there remains a significant theoretical and empirical gap in explaining how organizational structures, digital governance, and HR strategies interact to influence technostress and educational effectiveness simultaneously (Bencsik & Csinger, 2021; Daud, 2025).

This gap becomes more pronounced in non-formal education institutions, where organizational conditions differ substantially from those in formal systems. Institutions such as Community Learning Centers (PKBM), Course and Training Institutions (LKP), and Learning Activity Centers (SKB) operate under flexible schedules, heterogeneous learner profiles, and uneven technological infrastructure (Saquing, 2023; Ciarla & Mantovani, 2023). Tutors and

instructors often perform overlapping roles, including teaching, administrative reporting, and mandatory digital training, while facing limited technical support and fragmented digital resources (Mhlongo et al., 2023; Mhlanga, 2024). These conditions create a structurally complex environment in which digitalization simultaneously functions as an enabler of innovation and a source of systemic work pressure. However, empirical research examining technostress in such contexts remains scarce, particularly in developing countries such as Indonesia (Sari, 2024; Khaerudin, 2024), leaving a critical contextual gap in the literature.

From a theoretical standpoint, the limitation of existing research also lies in the lack of integrative frameworks linking individual adaptation to organizational systems. The Ability–Motivation–Opportunity (AMO) framework offers a robust foundation to address this limitation by conceptualizing performance as a function of individual capability (ability), motivational drivers (motivation), and organizational support structures (opportunity) (Edgar et al., 2021; Bos-Nehles et al., 2023). However, prior studies have rarely integrated the AMO framework with technostress theory to explain how these dimensions interact in digitally transforming educational environments. Without such integration, technostress remains narrowly interpreted as a psychological burden rather than a strategically manageable organizational phenomenon (Ballangan et al., 2024; Akbar et al., 2025).

To address these gaps, this study introduces three novel contributions. First, it reconceptualizes technostress as an organizationally embedded phenomenon, shifting the analytical focus from individual coping to structural and HRM-driven mechanisms within non-formal education. Second, it develops a theoretical integration between technostress dimensions and the AMO framework, providing a systematic explanation of how ability, motivation, and organizational opportunity interact to shape digital stress and teaching effectiveness. Third, it moves beyond explanatory analysis by producing an evidence-based HRM intervention model and operational standard operating procedures (SOPs) that translate theoretical insights into actionable strategies for sustainable digital transformation in resource-constrained educational settings.

Empirically, this study focuses on non-formal education institutions in Kendari City, Indonesia, where digitalization initiatives have intensified in recent years. It investigates how technostress emerges among tutors and instructors, how it affects key indicators of learning effectiveness such as attendance, program completion, teaching quality, and participant satisfaction, and how HRM strategies grounded in the AMO framework can serve as practical interventions. Strategies examined include microlearning and micro-credential programs, coaching mechanisms, administrative digitalization, structured helpdesk systems, and feedback-based incentive schemes (Iswandari et al., 2023; Abas et al., 2025).

Accordingly, this study aims to: (1) map the forms and organizational sources of technostress experienced by tutors and instructors in non-formal education institutions; (2)

examine the relationship between technostress and learning effectiveness indicators; and (3) develop and validate an evidence-based HRM intervention model and operational SOP based on the AMO framework to support sustainable digitalization practices. By integrating technostress theory with strategic HRM perspectives, this study contributes theoretically to the growing discourse on digital transformation in education and practically by offering implementable organizational strategies for managing digital work environments. Ultimately, the study argues that successful digitalization in non-formal education requires not only technological adoption but also balanced organizational support systems that protect educators' well-being while enhancing learning effectiveness.

2. METHODS

Describe the methods/designs/procedures used in the study, and provide exposure to the research site in general and research subjects in detail.

2.1. Research Design and Philosophical Positioning

This study employed a qualitative multi-site case study design to explore how technostress emerges and is managed within non-formal education institutions undergoing digital transformation. The study was grounded in an interpretivist paradigm, which assumes that organizational phenomena such as technostress are socially constructed and shaped by participants' lived experiences, institutional contexts, and interactional processes. This paradigm was considered appropriate because the research aimed to understand meanings, perceptions, and organizational practices rather than to test predetermined causal relationships.

A multi-site approach was adopted to capture contextual variation across different types of non-formal education institutions, including Community Learning Centers (PKBM), Course and Training Institutions (LKP), and Learning Activity Centers (SKB). Comparing multiple institutional settings enabled the study to identify both shared patterns and context-specific dynamics in digitalization and human resource management practices.

2.2. Research Setting and Participant Selection

The study was conducted in non-formal education institutions in Kendari City, Indonesia, where digitalization initiatives have intensified in recent years. Participants were selected using purposive sampling to ensure the inclusion of stakeholders directly involved in digital learning and human resource management processes. Participants included: 1) institutional leaders and administrators, 2) tutors and instructors, 3) IT support personnel, and 4) program participants (learners).

Selection criteria emphasized candidates with direct experience in digital teaching systems, administrative digitalization, or technology-related organizational changes. Data

collection continued until theoretical saturation was achieved, defined as the point at which no substantially new themes emerged from subsequent interviews or observations.

The study involved a total of 56 participants across multiple non-formal education institutions, consisting of:

a. 25 institutional leaders, tutors, and instructors
b. 31program participants (learners)

Participants were drawn from 5 institutions, including Community Learning Centers (PKBM), Course and Training Institutions (LKP), and Learning Activity Centers (SKB). The sample size was considered adequate for qualitative inquiry, as data collection continued until theoretical saturation was reached, at which point no new themes emerged from subsequent data.

2.3. Data Collection Procedures

Data were collected using multiple qualitative techniques to ensure depth and triangulation:

a. In-depth interviews were conducted to explore participants' experiences with digital workload, technological adaptation, organizational support, and perceptions of technostress. Interviews were semi-structured, allowing flexibility to probe emerging themes.
b. Non-participant observations were carried out during teaching activities and digital administrative processes to capture real-time interactions between tutors and technological systems.
c. Document analysis included institutional SOPs, digital competency standards, recruitment and training records, performance evaluations, attendance data, participant feedback reports, and IT service logs (SLA documentation). These documents were used to validate interview findings and identify organizational patterns.

Supporting quantitative indicators were collected to strengthen analytical convergence, including a brief technostress index questionnaire, teaching observation rubrics, participant satisfaction instruments, and IT ticket logs. The technostress questionnaire was administered via an online survey platform (e.g., Google Forms) to 25 participants, including tutors, institutional staff, and learners across the selected institutions.

Responses were measured using a five-point Likert scale (1 = strongly disagree, 5 = strongly agree), following the Likert (1932) scaling approach. Scores were aggregated by calculating the mean for each participant, which was then used to classify technostress levels as low, moderate, or high. Although Likert data are ordinal, previous methodological studies suggest that they can be treated as interval data for mean-based analyses in social research contexts (Joshi et al., 2015; Taherdoost, 2019).

The quantitative data were analyzed descriptively to generate frequency distributions, mean scores, and cross-case comparisons. These results were used to complement qualitative findings and strengthen data convergence within the convergent mixed-method design.

2.4. Data Analysis Strategy

Data analysis followed a systematic multi-stage coding process inspired by grounded theory procedures, enabling progressive abstraction from raw data toward conceptual themes.

Open Coding

The first stage involved open coding (Figure 1), in which interview transcripts, observation notes, and documents were examined line by line to identify meaningful units of information. Initial codes represented recurring experiences related to digital work demands, technological complexity, organizational support, and work–life boundaries. This stage generated approximately 50–100 initial codes reflecting diverse participant experiences.

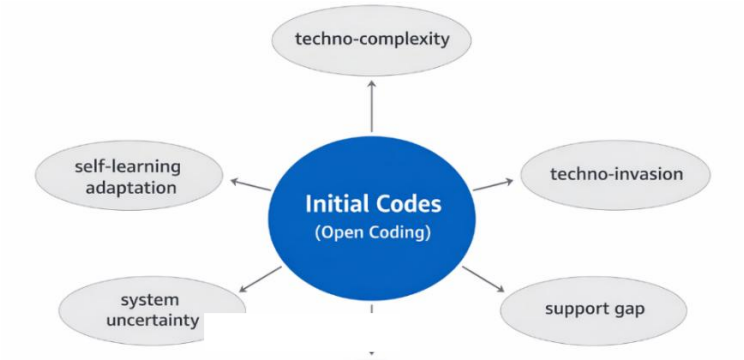

Figure 1. Initial Code (Open Coding)

Axial Coding

During axial coding (Table 1), initial codes were grouped into higher-order conceptual categories. These categories were organized around four primary technostress dimensions: techno-overload, techno-complexity, techno-uncertainty, and techno-invasion. At this stage, relationships between categories were examined and linked to the Ability–Motivation–Opportunity (AMO) framework to explain how individual competence, motivational factors, and organizational support influenced technostress experiences.

Table 1. Dimensions and Example Codes from Open Coding

Dimension	Example Codes
Overload	Increased reporting workload; multitasking; additional administrative tasks; limited time
Complexity	LMS is difficult to use; AI is perceived as a confusing, complex application with features and technical difficulties
Uncertainty	Sudden system updates, policy changes, lack of socialization, and unclear information
Invasion	Work-related WhatsApp interruptions; messages outside working hours; working at night; blurred work–life boundaries

Selective Coding

The final stage involved selective coding, which integrated categories into overarching themes that explained the organizational dynamics underlying technostress. Four core themes emerged: (1) digital overload without systemic support, (2) unequal digital competencies, (3) weak organizational support systems, and (4) blurred work–personal boundaries. These themes formed the basis for developing the conceptual model and operational SOP proposed in this study. To enhance analytical rigor, coding decisions were documented in analytical memos, and researchers conducted peer debriefing sessions to ensure consistency and minimize subjective bias.

Analysis Matrix

To clarify the relationships among variables, an analysis matrix was developed to link factors, AMO dimensions, impacts, and solutions (Table 2). For example, a complex LMS was associated with the *ability* dimension and was found to contribute to work-related stress; therefore, the recommended solution was microlearning and phased training. Similarly, the absence of a helpdesk was categorized as an *opportunity* issue, leading to delays in problem resolution and underscoring the need to establish a structured helpdesk system. This matrix explicitly illustrates cause–and–effect relationships and strengthens the scientific argumentation relevant for publication in reputable journals.

Table 2. Matrix of Relationships among Factors – AMO – Impacts – Solutions

Factor	AMO Dimension	Impact	Solution
Complex LMS	Ability	Stress and confusion in system use	Microlearning and phased training
Confusing AI usage	Ability	Decreased digital self-confidence	Practical case-based training
High digital reporting workload	Motivation	Work fatigue (digital fatigue)	Administrative simplification
Digital multitasking	Motivation	Work overload	Clear task distribution
Sudden system updates	Opportunity	Work uncertainty	Standard operating procedures (SOPs) for system changes
Frequent policy changes	Opportunity	Slow adaptation	Regular socialization and guidance
Absence of the IT helpdesk	Opportunity	Delays in problem resolution	Establishment of a helpdesk/internal administrator
Limited technical support	Opportunity	Operational disruptions	Structured support system
Work chats at night	Motivation	Work–life conflict	Communication-hour policy

Factor	AMO Dimension	Impact	Solution
Work-related WhatsApp interruptions	Motivation	Reduced work–life balance	Digital communication ethics

Document analysis (Table 3) was conducted as part of data triangulation to obtain a comprehensive understanding of human resource governance, technology implementation, and the effectiveness of learning programs in nonformal education institutions. The documents were systematically analyzed through content identification, thematic categorization, and interpretation guided by the research analytical framework.

Table 3. Document Analysis Table

No.	Document Type	Focus of Review	Key Findings	Analytical Implications
1	HR and IT SOP	HR workflow, IT support, SLA, admin roles	SOPs regulate HR governance and digital systems, but technical support is not yet consistent.	Strengthening helpdesk functions and implementing digital SOPs are needed.
2	Digital Competency Standards	Competency levels, LMS, digital literacy, data security	Competency standards are clear, but gaps in skills exist among tutors	Continuous training and microlearning are required
3	Recruitment & Training Data	Recruitment criteria, digital training, microcredentials, AI	Digital and AI training has begun to be implemented, but adaptation remains gradual	Practical, needs-based training should be enhanced
4	Performance Evaluation Instruments	Pedagogical, professional, social aspects, and technology utilization	Performance evaluation is structured and includes technology aspects	Evaluation can be used as a basis for competency development
5	Attendance & Program Completion Data	Attendance rate and program achievement	Attendance is related to program completion rates	Digital-based participation improvement strategies are needed
6	Participant Feedback	Satisfaction, learning quality, system support	Participants consider materials relevant, but technical support	Improvements to digital learning support services are required.

No.	Document Type	Focus of Review	Key Findings	Analytical Implications
			still needs improvement.	
7	Welfare & Incentive Data	Honorarium, incentives, work motivation	Incentive systems exist, but do not always consider the digital workload	Incentives should be integrated with technology-related workload
8	Scheduling Documents	Time allocation, task distribution, and learning modes	Schedules are structured, but digital flexibility extends working hours	Work–life balance boundaries need to be regulated

Core Themes

a. Digital Overload without System Support

This condition describes the increasing digital workload resulting from technology use that is not balanced by adequate support systems. It is characterized by limited technical guidance, insufficient IT administrative support, and growing multitasking demands in daily tasks. As a result, individuals experience higher work pressure as they must adapt to technology without sufficient organizational support. This phenomenon can be understood through the Overload dimension, which relates to high digital work demands, and the Opportunity dimension, which reflects limited organizational support and resources for effective use of technology.

b. Digital Competency Gap

This condition indicates differences in digital abilities among individuals, causing some users to have difficulty understanding digital systems, Learning Management Systems (LMS), and artificial intelligence (AI) technologies. These competency gaps lead to variations in adaptation levels and in the effectiveness of technology use across work and learning processes. Some individuals adapt quickly, while others require more time or additional support. This phenomenon can be explained by the Complexity dimension, which relates to technological difficulty, and the Ability dimension, which emphasizes the role of individual digital competence in successful adaptation.

c. Weak Support System

This condition reflects limited institutional support for technology implementation, characterized by insufficient training, limited socialization of system changes, and relatively slow technical responses to problems. These limitations create uncertainty for users adapting to continuously evolving technologies, potentially increasing work stress and reducing the effectiveness of digital system use. This phenomenon is explained by the Uncertainty

dimension, which relates to unclear information and system changes, and the Opportunity dimension, which reflects limited organizational support and resource availability.

d. Work–Life Balance Conflict

This condition shows blurred boundaries between work and personal life due to digital communication demands occurring outside working hours. The continuous use of communication technology encourages individuals to remain responsive to work-related messages or tasks, thereby disrupting personal time and reducing work–life balance. This situation may affect psychological well-being and decrease work motivation in the long term. This phenomenon can be explained through the Invasion dimension, which refers to work entering personal space via digital technology, and the Motivation dimension, which illustrates how pressure from digital communication affects work engagement and individual well-being.

Convergent Mixed Analysis

Although the study was primarily qualitative, a convergent mixed-methods analysis was used to integrate qualitative findings with supporting quantitative indicators. This strategy enabled cross-validation between narrative data and measurable indicators, such as technostress scores, participant satisfaction levels, and IT service response times. Joint display tables (Table 4) were used to compare and synthesize findings across data types, strengthening interpretive credibility and providing a more comprehensive understanding of organizational dynamics.

Table 4. Document Analysis and Convergent Evidence

No	Document Type	Focus of Review	Main Findings (Qualitative)	Analytical Implications
1	HR and IT SOP	HR workflow, IT support, SLA, admin roles	SOPs regulate HR governance and digital systems; however, technical support remains inconsistent.	Strengthening helpdesk services and enforcing digital SOP implementation
2	Digital Competency Standards	Competency levels, LMS, digital literacy, data security	Competency standards are clearly defined, but disparities exist among tutors	Continuous training and microlearning programs are needed
3	Recruitment and Training Data	Recruitment criteria, digital training, microcredential, and AI	Digital and AI-based training has been introduced, yet adaptation remains gradual	Practical, needs-based training should be enhanced
4	Performance Evaluation Instruments	Pedagogical, professional, social aspects, and technology utilization	Performance evaluation is structured and includes technology-related indicators	Evaluation results can serve as a basis for competency development

No	Document Type	Focus of Review	Main Findings (Qualitative)	Analytical Implications
5	Attendance and Program Completion Data	Attendance rate and program outcomes	Attendance is strongly associated with program completion rates	Digital-based participation improvement strategies are required
6	Participant Feedback	Satisfaction, learning quality, system support	Participants consider materials relevant; however, technical support still needs improvement.	Improvements to digital learning support services are necessary.
7	Welfare and Incentive Data	Honorarium, incentives, work motivation	Incentive systems exist, but do not always consider the digital workload	Incentive schemes should be integrated with technology-related workload
8	Scheduling Documents	Time allocation, task distribution, and learning modes	Schedules are structured, yet digital flexibility extends working hours	Work–life balance regulations need to be strengthened

Trustworthiness and Research Rigor

To ensure research quality, the study adhered to the trustworthiness criteria proposed by Lincoln and Guba, including credibility, transferability, dependability, and confirmability.

a. Credibility was strengthened through triangulation of data sources, methods, and participant groups.
b. Member checking was conducted by returning summarized findings to participants for validation.
c. Peer debriefing helped challenge interpretations and reduce researcher bias.
d. Audit trails were maintained through systematic documentation of coding decisions, analytical memos, and iterative revisions.

In addition, researchers maintained reflexive notes throughout the research process to acknowledge positionality and minimize interpretive bias during analysis. In addition to these strategies, coding validity was further ensured through intercoder agreement procedures, where two independent researchers coded a subset of the data to assess consistency. Differences in coding were discussed and resolved through iterative consensus to enhance analytical reliability. Furthermore, the integration of qualitative and quantitative data was validated through a convergent mixed-methods analysis, in which quantitative indicators (e.g., technostress scores, satisfaction levels, and IT response data) were systematically

compared with qualitative themes using joint display techniques. This process ensured consistency, complementarity, and triangulation across data sources.

Development of Conceptual Model and SOP

Based on the integrated analysis, a data-driven conceptual model was developed using a logic model framework (Input–Process–Mechanism–Outcome). The model illustrates how digital competence, motivation, and organizational support serve as key mechanisms that influence work performance and well-being outcomes. Subsequently, an evidence-based operational SOP was formulated, incorporating digital workflow structures, role distribution, helpdesk systems, monitoring procedures, and evaluation mechanisms. The SOP was derived directly from empirical findings to ensure contextual relevance and practical applicability.

3. RESULT AND DISCUSSION

RESULT

3.1. Distribution of Technostress Levels

The analysis of mean scores indicates that technostress is distributed across three levels: low, moderate, and high. The results show (Figure 2) that the majority of participants experience low levels of technostress, followed by moderate levels, while only a small proportion fall into the high technostress category.

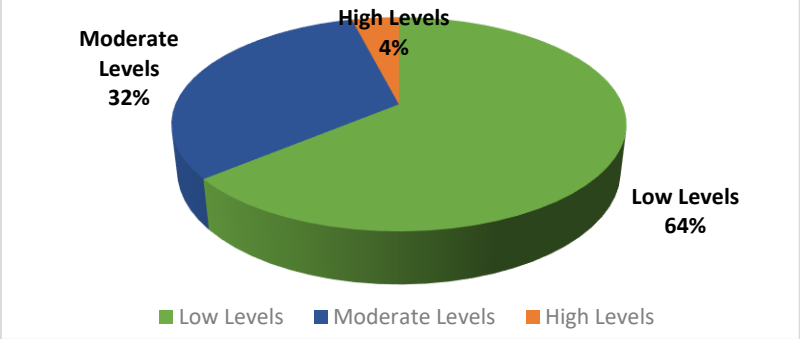

Figure 2. Distribution of Technostress Levels

This distribution suggests that most educators in non-formal education institutions can adapt to digital demands, although varying degrees of stress remain present.

Item-Level Analysis of Technostress Dimensions

A closer examination of individual questionnaire items reveals variation across different dimensions of technostress. The highest mean scores are found in items related to continuous learning demands and system updates, indicating that participants frequently feel the need to relearn or adapt to evolving digital systems.

In contrast, items related to system complexity and work–life balance disruption show relatively lower mean scores, suggesting that not all aspects of technostress are equally

experienced. This indicates that, in this context, technostress is more strongly associated with adaptation pressure than with technological difficulty itself.

Classification of Technostress Levels Based on Convergent Indicators

To strengthen analytical interpretation, technostress levels were further classified using convergent indicators, including technostress scores, participant satisfaction, and IT service response times.

Table 5. Classification of Technostress Levels

Level	Score Range	Characteristics	Organizational Condition
Low	≤ 2.5	Minimal stress, stable adaptation	Strong support, clear SOP, responsive IT
Moderate	2.6–3.5	Occasional stress, cognitive load	Partial support, inconsistent systems
High	> 3.5	High stress, fatigue, pressure	Weak support, unclear procedures

The table shows that lower technostress levels are associated with well-structured organizational environments, whereas higher stress levels are associated with limited support and unclear digital governance.

Convergent Mixed Analysis Findings

The integration of qualitative and quantitative data through convergent analysis provides deeper insight into the nature of technostress. While quantitative data identifies the intensity and distribution of stress, qualitative findings explain the underlying organizational causes. The results indicate that:

a. Low technostress is linked to structured workflows, effective communication, and reliable technical support
b. Moderate technostress reflects transitional organizational conditions with partial system implementation
c. High technostress occurs in environments characterized by weak institutional support and unclear administrative processes
d. This convergence confirms that technostress is not solely determined by technological exposure but is significantly shaped by organizational factors.

3.2. Digital Workload and Contextualized Experiences of Techno-Overload

Findings indicate that perceptions of digital workload were not uniformly experienced among participants but varied with institutional support structures and individual digital readiness. Tutors working in institutions with structured training and clearer digital workflows reported lower perceived overload. In contrast, those working in environments characterized by frequent system updates and limited guidance experienced significantly higher stress levels. This suggests that techno-overload emerged not merely from the quantity of digital tasks but from the interaction between workload demands and organizational support mechanisms.

Participants frequently described increased workload during system transitions or when new digital tools were introduced without prior explanation. As one tutor explained, "The workload increases mainly when systems change suddenly without clear guidance." This pattern was consistently observed across institutions lacking structured technical support. Supporting institutional documents and IT service logs also showed longer response times in organizations with limited helpdesk capacity, reinforcing the perception of systemic overload.

Cross-site comparison revealed that institutions implementing regular digital training and administrative simplification experienced more stable adaptation processes, indicating that techno-overload was conditional rather than universal. These findings demonstrate that organizational design plays a mediating role in shaping digital workload experiences.

3.3. Unequal Digital Competencies and Adaptive Strategies

A second major pattern concerned disparities in digital competence among tutors and instructors. While some participants perceived digital systems as manageable, others reported difficulties understanding LMS features and AI-based tools, particularly when formal socialization or training was absent. The variation in adaptation highlighted the roles of individual ability and institutional learning environments.

Participants frequently relied on self-directed learning strategies, including online tutorials and peer assistance, indicating the emergence of informal coping mechanisms. One participant noted, "When new features appear, I usually learn independently or ask colleagues." This reliance on informal learning was more prevalent in institutions where training programs were irregular or inconsistent.

Document analysis confirmed that although digital competency standards formally existed, implementation varied across institutions. As a result, digital adaptation occurred unevenly, creating differences in confidence and efficiency. These findings suggest that techno-complexity is not solely a function of technological design but also reflects disparities in institutional investment in capacity building.

3.4. System Uncertainty and Organizational Support Gaps

System changes and limited technical support emerged as significant sources of uncertainty among participants. While some tutors adapted comfortably to technological updates, anxiety increased when changes occurred without adequate communication or training. Participants emphasized that uncertainty was less about technological change itself and more about the unpredictability of implementation processes.

IT service documentation revealed that formal support mechanisms existed but were inconsistently experienced across sites. In several institutions, delays in technical responses

contributed to perceptions of institutional unreliability, reinforcing feelings of techno-uncertainty. These findings highlight a discrepancy between formal policy structures and everyday operational realities.

Cross-case analysis showed that institutions with proactive communication practices and clear update protocols reported fewer uncertainty-related complaints. This indicates that organizational communication serves as a buffer against technology-induced uncertainty.

3.5. Blurred Work–Personal Boundaries and Techno-Invasion

Digital communication practices contributed to the blurring of boundaries between work and personal life. Although many participants reported being able to manage digital demands, communication outside official working hours remained common. Participants described receiving work-related messages via instant messaging platforms in the evenings or on weekends, reflecting expectations of constant responsiveness.

Interestingly, the intensity of techno-invasion varied depending on institutional communication norms. Institutions with informal communication cultures exhibited higher rates of after-hours messaging, while those with clearer digital communication guidelines reported fewer instances of work–life interference. This suggests that techno-invasion is shaped less by technology itself and more by organizational culture and implicit expectations.

These findings indicate that digital flexibility, while supporting responsiveness, simultaneously risks expanding work demands into personal time, potentially affecting long-term motivation and well-being.

3.6. Teaching Quality and Digital Interaction Dynamics

Participants generally perceived the teaching quality as satisfactory, particularly in the clarity of content delivery. However, variation emerged in terms of interaction quality and learner engagement. Tutors managing multiple subjects or facing high digital administrative demands reported fewer opportunities for interactive learning.

Observation data confirmed that classes with lower administrative pressure demonstrated more active two-way interaction, whereas classes characterized by multitasking demands tended toward more instructor-centered delivery. This suggests that digital workload indirectly influences pedagogical practices by limiting cognitive and temporal resources available for interactive teaching.

These findings highlight the interconnected nature of technostress and instructional quality, indicating that digital pressures extend beyond administrative tasks and influence core learning processes.

3.7. Participant Satisfaction and Perceived Value of Digital Programs

Most participants expressed satisfaction with program relevance and the perceived value of microcredential initiatives. Learners viewed digital certification as beneficial for skill

recognition and career development. However, satisfaction levels varied depending on the consistency of organizational support and technical facilitation.

Institutions with structured coaching and clearer digital guidance reported higher participant satisfaction, whereas environments with limited support yielded more mixed evaluations. This pattern suggests that satisfaction is strongly influenced by the quality of organizational implementation rather than by program design alone.

3.8. Coaching and Support Mechanisms as Moderating Factors

Coaching emerged as an important moderating factor influencing digital adaptation. Participants who received intensive mentoring reported increased confidence and reduced stress when using digital systems. Conversely, coaching perceived as infrequent or generic had a limited impact.

Cross-site comparison revealed that coaching effectiveness depended on the quality of interactions and alignment with individual needs. Institutions that integrated coaching into routine professional development demonstrated more positive adaptation patterns than those that treated coaching as a one-time intervention.

These findings indicate that supportive organizational practices can serve as protective mechanisms against technostress, reinforcing the importance of sustained, rather than episodic, support structures.

DISCUSSION

4.1. Distribution and Implications of Technostress Levels

The quantitative analysis of Likert-scale responses reveals that technostress among participants is not uniformly distributed but varies across three distinct levels. Based on the mean score classification, approximately 64% of participants fall into the low technostress category, 32% into the moderate category, and only 4% into the high technostress category. This distribution indicates that, although digital transformation has introduced additional demands, the majority of educators in non-formal education institutions are still able to maintain relatively stable levels of adaptation.

However, this finding should not be interpreted as evidence that technostress is insignificant. A closer examination suggests that even within the low-stress group, certain dimensions of technostress—particularly continuous learning demands and system updates—remain consistently present. This aligns with the item-level analysis, where the need for ongoing adaptation (e.g., frequent system updates) emerged as one of the highest-scoring indicators. Thus, technostress in this context tends to manifest as chronic low-intensity pressure rather than acute high-intensity stress.

The moderate technostress group (32%) represents a critical segment that reflects transitional organizational conditions. Participants in this category typically operate in

environments where digital systems are available but not fully supported by consistent institutional mechanisms. As a result, they experience fluctuating levels of uncertainty, increased cognitive load, and occasional inefficiencies in digital workflows. This finding reinforces the argument that technostress is strongly influenced by organizational readiness and support systems, rather than technological exposure alone.

Although the high-stress category (4%) appears relatively small, its significance should not be underestimated. Participants in this group reported higher levels of workload pressure, slower IT support response, and stronger perceptions of mental fatigue. These conditions are often associated with weak organizational structures, unclear digital procedures, and extended working hours due to digital demands. From a critical perspective, this suggests that technostress is not evenly distributed but disproportionately affects individuals operating within less supportive institutional environments.

Importantly, the distribution of technostress levels also reveals a clear relationship with learning effectiveness. Participants in the low-stress category tend to demonstrate higher teaching quality, better interaction with learners, and more stable attendance and completion rates. In contrast, moderate and high stress levels are associated with reduced instructional engagement and increased cognitive burden, which may limit the effectiveness of learning processes. This finding confirms that technostress functions not only as a psychological condition but also as a determinant of educational performance.

From a broader perspective, these results challenge the dominant assumption that digitalization inherently improves educational outcomes. Instead, they demonstrate that the benefits of digital transformation are contingent on the organization's capacity to manage technostress effectively. Globally, this insight is particularly relevant as education systems increasingly adopt digital technologies without proportional investment in human resource support systems. Without adequate organizational mediation, digital transformation may reproduce inequalities in adaptation capacity and negatively impact teaching effectiveness. The integration of quantitative distribution and qualitative insights confirms that technostress is a graded, context-dependent, and organizationally mediated phenomenon. Therefore, interventions should not only aim to reduce extreme stress levels but also address moderate and latent forms of technostress that may accumulate over time and gradually affect educator performance and well-being.

4.2. Reframing Technostress as an Organizational Phenomenon

This study demonstrates that technostress within non-formal education institutions cannot be fully understood as an individual psychological response to technology. Instead, findings indicate that technostress emerges from the interaction between digital demands and organizational structures. While prior research frequently emphasizes individual coping mechanisms and personal adaptability (Liang & Cao, 2021; Bondarchuk et al., 2024), such

perspectives risk underestimating the structural conditions under which digital work is performed. The present findings, therefore, not only complement but also challenge the dominance of individual-centered explanations by demonstrating that organizational conditions play a more decisive role in shaping technostress experiences in non-formal education contexts.

Specifically, techno-overload was not universally experienced but appeared primarily in institutions lacking structured digital workflows and technical support. This finding extends earlier work suggesting that technology increases workload demands (Tams et al., 2020; Zinke et al., 2024) by demonstrating that overload is not an inherent consequence of technology itself but is mediated by institutional design and governance structures. In this sense, technostress should be conceptualized as a systemic outcome shaped by organizational governance, resource allocation, and digital management practices, rather than as an unavoidable byproduct of digitalization.

This perspective aligns with recent calls to shift technostress research toward organizational-level explanations (La Torre et al., 2020; Kumar et al., 2024), yet it goes further by explicitly positioning technostress as a preventable organizational condition. This insight has broader global relevance, particularly as education systems worldwide accelerate digital transformation. Without adequate organizational design, digitalization initiatives risk reproducing structural inefficiencies and shifting the burden of adaptation onto individual educators.

4.3. Digital Competency Inequality and the Ability Dimension of AMO

Findings related to techno-complexity highlight substantial disparities in digital competence among tutors and instructors. Consistent with prior studies demonstrating that digital literacy reduces perceived technological stress (Vermisli et al., 2022; Peng & Yu, 2022; Maftei et al., 2023), this study confirms that individual ability remains a critical determinant of adaptation. However, the results further suggest that ability alone is insufficient when organizational learning systems are weak.

Participants often relied on informal coping strategies such as peer learning or self-directed tutorials, indicating that institutional training mechanisms were unevenly implemented. This finding extends the AMO framework by illustrating that ability should not be treated solely as an individual characteristic but as a socially constructed capability shaped by organizational investment in learning opportunities (Vermisli et al., 2022; Hussain et al., 2022).

Thus, techno-complexity emerges not only from technological design but from mismatches between system complexity and institutional learning infrastructures. This insight challenges dominant assumptions that technological usability alone determines adaptation outcomes.

4.4. Organizational Support and Techno-Uncertainty: The Role of Opportunity

One of the most significant findings concerns the role of organizational support in shaping techno-uncertainty. While previous studies have linked uncertainty to rapid technological change (Cram et al., 2022; Pflügner et al., 2024), the present findings complicate this assumption by demonstrating that uncertainty is not primarily driven by the pace of technological innovation but by a lack of institutional preparedness and clarity of communication.

Participants reported heightened anxiety, not because technologies were inherently complex, but because system changes were introduced without structured communication, training, or transitional support. This suggests that techno-uncertainty is less a technological issue and more an organizational coordination failure. Such a perspective challenges deterministic views of technology as the main driver of stress and instead highlights the role of governance and managerial processes.

Within the AMO framework, this finding underscores the centrality of the opportunity dimension as a structural enabler of adaptation. However, the study goes further by demonstrating that opportunity is not merely a facilitating factor but a decisive condition that determines whether digital transformation produces empowerment or disruption.

This has important global implications. In many education systems, particularly in developing regions, digital transformation initiatives are often implemented rapidly without parallel investment in organizational capacity. The findings suggest that without adequate institutional support systems, digitalization may unintentionally amplify inequality, uncertainty, and inefficiency. Therefore, strengthening organizational opportunity is not only a managerial concern but a policy imperative for ensuring equitable and sustainable digital transformation across diverse educational contexts**.**

4.5. Techno-Invasion and the Motivation Dimension

The study also reveals that techno-invasion—manifested through after-hours digital communication—represents a significant challenge for maintaining work–life boundaries. Previous research has shown that constant digital connectivity can reduce psychological recovery and increase emotional exhaustion (Siegl, 2023; Supriyadi et al., 2025; Huusko & Sivunen, 2025). The present findings extend this understanding by showing that techno-invasion is strongly shaped by organizational communication culture rather than by technological availability alone.

From an AMO perspective, techno-invasion primarily influences the motivation dimension. When work expectations extend into personal time, intrinsic motivation and long-term engagement may decline, even among digitally competent educators. This finding supports broader research in organizational behavior, indicating that motivation is closely tied to perceived control over work boundaries (Syaputra & Hasanah, 2022; Fossen et al., 2025; Li et al., 2025).

Importantly, institutions with clearer communication norms experienced lower levels of perceived invasion, suggesting that organizational policies can effectively mitigate motivational risks associated with digital work environments.

4.6. Linking Technostress to Teaching Effectiveness

An important contribution of this study is its demonstration that technostress extends beyond individual well-being to influence core educational processes directly. While prior research has established a general relationship between technostress and reduced performance (Di Dalmazi et al., 2022; Picazo Rodríguez et al., 2024), the present findings provide a more nuanced explanation by identifying the mechanisms underlying this effect.

Specifically, digital workload and techno-uncertainty were found to constrain pedagogical interaction by reducing the cognitive and temporal resources available for teaching. This suggests that technostress does not merely coexist with teaching activities but actively reconfigures instructional practices, often shifting them toward less interactive, more instructor-centered approaches.

This finding challenges the prevailing assumption that digitalization inherently enhances the quality of learning. Instead, it reveals a paradox: while digital technologies are introduced to improve educational outcomes, their mismanagement at the organizational level may inadvertently undermine the very pedagogical processes they aim to support.

Globally, this insight is particularly relevant as education systems increasingly rely on digital platforms to expand access and efficiency. Without careful alignment between technological implementation and organizational capacity, digital transformation risks producing superficial gains in efficiency while compromising deeper dimensions of learning quality.

4.7. Theoretical Contributions

This study offers three key theoretical contributions. First, it extends technostress theory by demonstrating that technostress in non-formal education is structurally embedded within organizational practices rather than solely driven by individual technological adaptation. Second, it advances the AMO framework by showing dynamic interactions among ability, motivation, and opportunity in digital work environments. Specifically, opportunity (organizational support) emerged as a critical condition that amplifies or suppresses the effects of ability and motivation. Third, the study integrates technostress and strategic HRM perspectives, positioning digital stress management as an organizational design issue rather than a purely psychological problem. This integration contributes to ongoing discussions about sustainable digital transformation in education.

4.8. Practical and Policy Implications

From a practical perspective, findings suggest that digital transformation strategies should prioritize organizational support mechanisms, including structured training,

administrative simplification, and responsive helpdesk systems. Coaching and microlearning programs were identified as effective interventions when implemented continuously rather than episodically.

At the policy level, the study highlights the importance of institutional guidelines that regulate boundaries in digital communication to prevent techno-invasion and maintain educator motivation. These insights provide an evidence-based foundation for developing sustainable digital governance strategies within non-formal education institutions.

4.9. Toward an Organizational Model of Technostress Management

The conceptual model (Figure 2) proposed in this study offers broader implications beyond the specific context of non-formal education in Indonesia. By positioning technostress as an outcome of organizational mediation rather than technological determinism, the model provides a transferable framework applicable to diverse educational systems undergoing digital transformation.

In a global context, where digitalization is often promoted as a universal solution to educational challenges, this model highlights a critical limitation: technology alone does not guarantee improved outcomes. Instead, the effectiveness of digital transformation depends on the alignment between technological tools, human resource strategies, and organizational support systems.

This perspective is particularly important for low-resource and non-formal education sectors worldwide, where institutional capacity often lags behind technological adoption. The model thus contributes to a more realistic and context-sensitive understanding of digital transformation, emphasizing that sustainability requires not only innovation but also organizational readiness and the integration of strategic HRM.

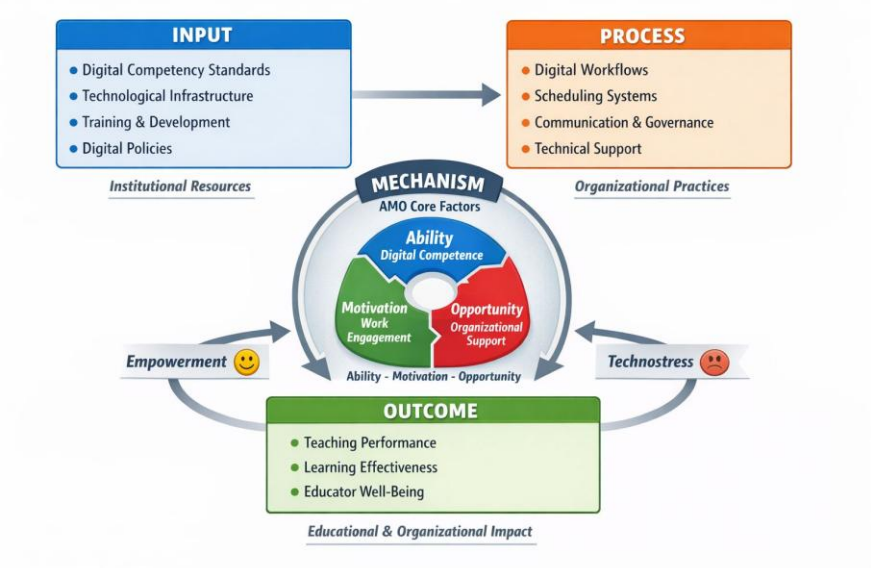

Figure 2. Model of Technostress Management (Generated by ChatGPT Plus; Prompted by authors, 2026)

The conceptual model illustrates that digital transformation outcomes are not directly determined by technology adoption itself but by the quality of organizational mediation processes. When continuous learning opportunities support digital competence, motivation is maintained through healthy work boundaries, and organizational opportunity is strengthened through effective support systems, digitalization tends to produce positive outcomes such as improved teaching quality and professional empowerment.

Conversely, when organizational support is weak, even high levels of individual ability may fail to prevent technostress. In such conditions, educators experience increased workload pressure, uncertainty toward system changes, and blurred work–personal boundaries, leading to reduced motivation and declining instructional effectiveness. Thus, organizational opportunity emerges as a critical enabling condition that amplifies or suppresses the effects of ability and motivation.

The model, therefore, reframes technostress as a dynamic organizational process rather than a fixed individual condition. It emphasizes that sustainable digitalization requires alignment between technological adoption, human resource strategies, and organizational culture. By integrating technostress dimensions with AMO mechanisms, the model provides a practical and theoretical foundation for designing intervention strategies to reduce digital stress and enhance educator performance and well-being.

5. CONCLUSION

This study examined the dynamics of technostress within non-formal education institutions undergoing digital transformation and explored how human resource management strategies grounded in the Ability–Motivation–Opportunity (AMO) framework can mitigate its negative effects. The findings demonstrate that technostress is a multidimensional phenomenon shaped not only by technological demands but also by organizational structures, institutional support systems, and digital governance practices. Rather than being an inevitable consequence of digitalization, technostress emerges through the interaction between individual competencies and organizational conditions that either constrain or facilitate adaptation.

Importantly, the study reveals that technostress is not uniformly experienced; its intensity varies across participants. The quantitative distribution shows that 64% of participants fall within the low technostress category, 32% in the moderate category, and 4% in the high category, indicating that while extreme stress is relatively limited, a substantial proportion of educators experience moderate and potentially accumulative levels of digital strain. This finding suggests that technostress in non-formal education tends to manifest as a chronic, graded condition rather than an isolated or extreme phenomenon. Consequently, even low and moderate

levels of technostress should not be overlooked, as they may gradually influence educator performance and well-being over time.

The study contributes theoretically in three important ways. First, it extends technostress literature by repositioning technostress as an organizationally embedded phenomenon rather than solely an individual psychological response. Second, it advances the AMO framework by illustrating how the dimensions of ability, motivation, and opportunity dynamically interact in digital work environments, with organizational opportunity emerging as a critical mediator influencing adaptation outcomes. Third, the study integrates technostress theory with strategic human resource management perspectives, offering a more holistic explanation of how digital transformation affects educator performance and well-being within non-formal education contexts.

From a practical perspective, the findings highlight that successful digital transformation requires more than technological adoption. Institutions need structured organizational support, including continuous digital training, responsive helpdesk systems, administrative simplification, and clear communication policies that protect work–life boundaries. The evidence-based operational model and SOP developed in this study provide actionable guidance for educational institutions seeking to implement sustainable digitalization while maintaining educator well-being and learning effectiveness. In particular, addressing moderate levels of technostress should become a strategic priority, as this group represents the largest proportion of educators experiencing transitional adaptation challenges.

At the policy level, the study underscores the importance of integrating human-centered digital governance into education management strategies. Policymakers and institutional leaders should consider organizational readiness, digital workload management, and communication norms as essential components of digital transformation initiatives, particularly in resource-constrained non-formal education settings. These findings also carry broader global relevance, as many education systems face similar challenges in balancing rapid technological adoption with institutional capacity and workforce sustainability.

Despite its contributions, this study has several limitations. The research was conducted within a specific regional context, which may limit the generalizability of findings to other educational environments. In addition, although convergent mixed analysis strengthened interpretive validity, future studies could employ longitudinal or comparative quantitative designs to examine causal relationships and long-term impacts of technostress interventions.

Future research is encouraged to expand investigations across diverse institutional contexts, explore the role of techno-eustress as a positive dimension of digital engagement, and examine how organizational culture and leadership styles shape digital adaptation processes. Such studies would further enrich the understanding of sustainable digital transformation in education.

In conclusion, this study emphasizes that the success of digitalization in non-formal education depends on achieving a balance between technological innovation, organizational support, and strategic human resource management. Digital transformation becomes sustainable not when technology alone is implemented, but when institutions create supportive ecosystems that enable educators to adapt, perform, and thrive in increasingly digital work environments. Moreover, recognizing and managing the graded nature of technostress is essential to ensure that digital transformation enhances, rather than undermines, educational effectiveness.

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