

From Digital Transformation to Perceived Stress: The Mediating Role of Technostress among University Students in Pakistan

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Abstract

Objective: With the onset of the digital era, higher education institutions can observe both some benefits and negative outcomes concerning the impacts on students resulting in technostress. Hence, this research aimed to examine the mediation role of technostress between digital transformation and perceived stress in university students.

Method: For the study of the hypothesis, 300 students were selected as respondents from University of Gujrat in Pakistan in a quantitative cross sectional design study. Data collection was carried out by using the point measures of digital transformation (Pettersson et al., 2024), technostress (Wang et al., 2020), and perceived stress (Cohen et al., 1983).

Results: The results of the research indicated that there was positive influence of digital transformation on technostress ($B = .4153$, $p < .001$) and perceived stress ($B = .2353$, $p < .001$). Moreover, technostress had a significant influence on the level of perceived stress ($B = .2270$, $p = .0054$). The indirect effect of digital transformation on perceived stress via technostress was found to be significant ($B = .0943$, 95% CI [.0239, .1556]), showing that partial mediation existed. This model achieved in the research was able to explain the variability of the level of stress of 39.64%.

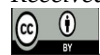
Conclusion: Results revealed that the moderating effect of technostress is present between digital transformation and perceived stress of the Pakistani university students. Based on the conclusion, it is stated that technostress must be addressed in order to help students stay well during the digital transformation of education through institutional assistance, digital literacy training, and policies that focus on their needs and interests.

Keywords: Digital transformation, technostress, perceived stress, university students, Pakistan, mediation analysis

Introduction

The advent of digital technology is undeniable and has changed the dynamics of the HE sector especially in developing countries such as Pakistan. Digital transformation, which involves the use of digital technology in various spheres of human activities and the changing processes of giving people value using these technologies, has been widely applied in education (Vial, 2019). Pakistan had also been a part of this transformation with the Higher Education Commission which has been conceptualizing several modern projects such as Datacenter of Astrolabes and the "Pakistan Digital Leap" which has introduced several innovations in 96 higher education institutions across the country (Higher Education Commission, 2022). Although such measures

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have provided people a chance to get useful information easily and to study at their convenience, they have also created various problems which can be detrimental to the students' mental state.

One of the problems is technostress, the stress resulting from the inability to cope with ICT stresses (Ragu-Nathan et al., 2008). Brod (1984) coined the concept and has described the 'technostress' as the 'illness of adapting to new technologies that involves an inability to adapt to technology smoothly' (p. 16). For students, technostress could be due to having to handle numerous online platforms, and a barrage of notifications as they attempt to pursue their studies. Evidence also indicates that technostress among students is rapidly increasing, particularly during the pandemic where it was found that the extent of use of the ICTs is a significant factor influencing the level of technostress (Sethi et al., 2022).

One of the most studied factors that affect people's mental health is perceived stress, which is the individual's self-evaluation of situations he or she encounters as being overwhelming (Cohen et al., 1983). Stress has been found to be linked to academic burnout, anxiety, depression and lower academic outcomes (Eisenberg et al., 2007). Research indicates that the pandemic resulted in a considerable level of stress for students, due to the sudden shift to online learning, among other factors (Cabras et al., 2024). The studies that compare perceived stress before and during the pandemic offer proof that stress levels of most respondents (71%) have increased during the COVID-19 pandemic compared to the time before it (Son et al., 2020).

The theoretical framework adopted in this paper is the Transactional Model of Stress and Coping (Lazarus & Folkman, 1984) that suggests that stress is a result of an interaction between a person and his environment. Stress is then seen as a general predisposition of the individual to respond to environmental stresses, and the stresses can either be excessive to the individual or can be those that arise from environmental events. In this context, the concept of digital transformation can be considered as an environmental impact that leads to technostress and consequently to experiencing stress. Conservation of Resources Theory (Hobfoll 2001) is another theory that states that all the human beings tend to protect their resources and become stressed when those resources they have are put at risk or lost. But, there was a lack of research on the mediation of technostress between digital transformation and perceived stress. Most of the studies on this phenomenon focus on stress situations in the workplace without considering some of the intervening mechanisms. Technostress research in the context of higher education has mainly focused on faculty members and not students (Penado Abilleira et al., 2021). Also, it's essential to analyze the cultural and contextual aspects that are peculiar to Pakistan since its digital technology infrastructure differs remarkably. Research has shown that technical issues concerning the utilization of technology in education are one of the prominent issues of technostress in Pakistan (Siddiqui et al., 2022).

Objectives of the research:

The following objectives are incorporated in the present study:

1. To study Digital transformation and Perceived stress in the context of University students in Pakistan.
2. To explore the impact of digital transformation on techno-stress of university students in Pakistan.

3. To determine the correlation between Techno-stress and Perceived stress of the university students of Pakistan.
4. To identify the mediation effect between the digital transformation and perceived stress by techno-stress.

Importance of the study

This study is important for a number of reasons. Firstly, it demonstrates the influence of technology introduced in Pakistani colleges on the mental wellbeing of students. Nowadays, many students believe that they should use various online platforms and digital tools while studying (Vial, 2019; Higher Education Commission, 2022). Although these technologies are quite useful, there is some pressure which they put on their users (Ragu-Nathan et al., 2008). This research identifies exactly how technological advancement impacts the stress level of students and hence in the future universities can better help their students. Previous research indicated that the techno stress of students has been increasing with the presence of the pandemic (Son et al., 2020).

Secondly, this study helps develop the existing knowledge on technostress. Most of the studies that people have conducted until now are in the workplace setting and have only been done in the developed world (Salanova et al., 2013). The topic of technostress has been explored in the current research on students of higher education institutions of Pakistan thus enriching the research with contribution from one of the developing countries. This is significant as the students in Pakistan may experience various issues like internet disconnection, electricity, or lack of digital literacy, which further add to the technostress levels (Siddiqui et al., 2022). Studies reveal that the relevant to technology usage is among the most significant sources of technostress to the nationals of the country (Siddiqui et al., 2022). Moreover, the studies conducted about technostress among students in Higher Educational Institutions mostly focused on teachers and neglected students learning technostress, (Penado Abilleira et al., 2021). Wang et al. (2020) said that studies on this topic have been lacking.

Based on this study, it is hoped that managers and policy makers of the university can make decisions based on the findings of the study. Universities can find a way to remove the negative side of digital transformation as they know that it can create issues and stress for students (Tarafdar et al., 2007). For instance, universities may create training courses for increasing the technological skills of students, or create rules regarding the use of software that will create an environment for students to work. The Higher Education Commission of Pakistan could utilize the results of the research to formulate national policies in the field of digital education.

This research is a boon for educators and champions in the field of education. Teachers can use teaching strategies that are based on the relationship between technostress and anxiety (Penado Abilleira et al., 2021). Educators will be aware of the proper use of technology to support students and not over-demand students in the digital world. According to some studies, perception of stress is connected to the experience of academic burnout, anxiety and depression as well as low academic performance (Eisenberg et al., 2007), which requires educators to be aware about this phenomenon. Then it's a matter of research being important for students. Technostress awareness allows students to recognize that technostress is a problem, and they are looking for help (Brod, 1984). In addition, the study offers students the opportunity to be familiar with cop-

ing strategies that can be used to manage stress based on the understanding of the Transactional Model of Stress and Coping (Lazarus & Folkman, 1984).

From the methodological perspective, this research proves to be significant since it employs the mediation model in order to study the connection between digital transformation and stress with technostress as mediation (Hayes, 2018). Conducting the research in such a way allows for revealing clearer interdependence of these two concepts than in case of direct effect studies (Baron and Kenny, 1986). The results achieved from the research will prove useful for future research in the field.

In conclusion, the research is of immense value and importance because the problem is gaining importance in the field of education in Pakistan, it is contributing to the literature of the field and it is providing solutions to the universities, authorities, teachers and students.

Literature Review

Theoretical Framework: For this study, the two theoretical frameworks depict the relationship between the digital transformation and perceived stress.

The Transactional Model of Stress and Coping

A model developed by Lazarus and Folkman (1984), the Transactional Model of Stress and Coping, is used to understand how individuals respond and cope with stress. Stress is not only an event or a reaction, but a process that occurs between the person and his or her environment, according to this model. There are two steps of cognitive appraisal; primary and secondary appraisal.

This study refers to digital transformation as an environmental demand that leads to the process of cognitive appraisal in students. Students make decisions about the requirements of new digital platforms, learning management systems, or technology-based teaching and learning methods that may negatively affect their academic achievement and health. If students feel that they lack some of the skills needed to deal with the demands imposed on them, such as digital literacy or time management skills, they will likely get stressed. This theoretical view has been used in research on technostress, with researchers maintaining that technostress occurs when the competence of an individual does not correspond to the requirements of the technology used (Tarafdar et al., 2007; Califf et al., 2020).

Conservation of Resources (COR) Theory

The theory of Conservation of Resources (COR) developed by Hobfoll in 1989, in addition to the transactional model of stress, states that people have a tendency to achieve, keep and help preserve valuable resources, which may refer to personal resources (e.g., abilities and special skills), social resources (e.g., social support) and material resources (e.g., time and energy). From the point of view of COR theory, stress is defined as the circumstances under which either (a) there is a risk of losing some resources, (b) resources are lost or (c) necessary resources are not acquired even after considerable efforts have been put in (Hobfoll, 2001).

Digital platforms require students to be cognitively, emotionally and socially engaged with others. If students' efforts are unsuccessful in achieving academic outcomes or if students realize

that they are spending a lot of energy fighting a losing battle with the digital devices, then they may feel stress (Hobfoll, 2001). This is a theoretical model that has been applied to the study of technostress in students, and it supports that technological challenges exhaust students' mental faculties, resulting in emotional exhaustion and loss of well-being (Buenadicha-Mateos et al., 2022). Apart from that, the current study has created the COR theory and the Job Demands-Resources model to demonstrate the effects of stress perception on the link between digital disparities and well-being in Higher Education (Hasan et al., 2026).

Digital Transformation in Higher Education

Digital transformation implies the incorporation of digital technologies in virtually all aspects of human endeavors and radically changing the way people work and create value (Vial, 2019). The higher education sector has seen this change in the form of the general adoption of learning management systems, online platforms, and technology-enhanced pedagogies. The COVID-19 pandemic has significantly speeded up this process necessitating universities to quickly switch to remote and hybrid education (Lin & Yu, 2025). The Higher Education Commission in Pakistan is promoting the agenda of digital transformation. Cloud computing, high performance computing and smart classrooms are increasingly being used in higher education (Higher Education Commission, 2022). However, the swift transition to digital education is not homogeneous, with many Pakistani students facing a number of issues, limited internet access, electricity shortages, and low levels of digital literacy (Siddiqui et al., 2022). Problems related to the digital shift are especially significant in rural areas where there are still many obstacles to digital participation (Hasan et al., 2026).

Although digital transformation has many positive aspects such as better access to information, flexibility in learning and diversity of methods in teaching and learning, there is increasing evidence to suggest that the implications for psychosocial well-being in individuals may be quite problematic. In one of the research classes, stress and fatigue due to frequent communication with information during digital online learning is shown (Daud, 2025; Polat, 2025). In addition, the research indicates that in countries of the developing world, hybrid learning is associated with increased levels of stress with a negative impact on students' well-being (Hasan et al., 2026).

Technostress in Students

In 1984, Brod coined the term "technostress" to refer to "a new-age ailment of adjustment that occurs when one is unable to deal with innovation in a healthy way" (p. 16). Ragu-Nathan, et al. (2008) modified this definition to state that technostress is the stress people go through due to their inability to deal with the requirements posed by the use of information and communication technologies. Specifically, in the educational field technostress can be felt as anxiety, stress, and exhaustion due to the constant demand that obligates students to work with digital technologies and to handle the notifications and changes in technologies rather quickly (Tarafdar, et al. (2007). The results of these systematic reviews indicate that the outbreak of the COVID-19 pandemic sparked an interest in the impact of technostress in the students' context, as it raised concerns about the issues stemming from the common experience of studying in remote learning situations (Lin & Yu, 2025). In the past few years, most studies have been based on technostress models and have created new models that incorporate the results of various studies. The role of extrinsic

factors has been highlighted, such as the role of digital literacy and sociodemographic variables (Lin & Yu, 2025).

Ragu-Nathan et al. (2008) identified five technologies that create technostress: Techno-overload (feeling overwhelmed with the amount of information that technology provides); Techno-invasion (users feel that they are constantly connected in their personal lives, which makes a lot of things more complicated); Techno-complexity (users feel that technology is too complex to comprehend); Techno-insecurity (users fear being replaced or overtaken by technology); and Techno-uncertainty (users feel that technology is constantly changing and updating, creating uncertainty). All these factors are tightly connected with the context of university students. They are dealing with many new technological platforms and trying to cope with new excessive information flows while at the same time keeping up with academic requirements in technology-saturated environment (Lin & Yu, 2025).

Research conducted in the context of developing countries has given valuable information on how prevalent technostress among university students is and what its correlates are. The results of the study carried out in Pakistan indicate that the technostress level among males is significantly higher than among females, but the degree of technostress and its impact on impulsiveness remains unknown (Khan et al., 2025). The studies carried out in Chile have also examined how technostress can be studied in students, emphasising the need for accurate measuring instruments in the measurement of online students (Araya-Ugarte et al., 2025).

Recent studies conducted in Pakistan show that the problems associated with the application of technology greatly contribute to the technological stress that students experience (Siddiqui et al., 2022). According to the studies, the use of digital devices like social media while studying causes inability to concentrate and study, creating high stress and failure in students' academic life. In addition, it is proposed that self-regulated learning could also be used as a barrier against technology distraction, and that students still use it to learn even when there are many tools around to distract them (R Discovery, 2025). Previous research indicates that technostress negatively affects students' learning experiences and performance (Lin & Yu, 2025). Technostress has been revealed to have a notable predictive power with respect to the emotional exhaustion of students in higher learning based on the perception of stress and conflicts of one's personality (Buenadicha-Mateos et al., 2022).

Perceived Stress in Academic Environments

Stress as experienced by the individual is the subjective appraisal of their ability to cope with demand and the phenomenon has been studied extensively as an important measure of mental health problems among students (Cohen et al., 1983). Eisenberg et al. (2007) found that high levels of perceived stress relate to academic burnout, anxiety, depression and poor academic performance. The pandemic has been identified as having caused a lot of stress for students for several reasons, such as the abrupt transition to distance learning (Agnew et al., 2019). The empirical study aimed at comparing perceived stress before and during the pandemic (Son et al., 2020) demonstrated forceful growth of perceived stress with 71% of the sample reporting an increase of perceived stress during COVID-19 compared to that before the pandemic came into action.

Studies have been conducted recently that suggest that there is a relationship between academic stress and student health outcomes that can be influenced by perceived stress. Hasan et al. (2026)

conducted a study in Indonesia and concluded that the perception of stress can mediate between the stress of blended education and the health outcomes of students, while the technological needs and digital inequalities form the framework of the psychosocial experience of students. The mediation of perceived stress can be the key to understanding the relationship between technostress and emotional exhaustion, as explained by Buenadicha-Mateos et al. (2022).

For Pakistan there are also studies that have explored the impact of technostress on health. Technostress was found in one study, for instance, to be able to predict bedtime procrastination, as well as sleep quality (Nature Scientific Reports, 2026). The authors concluded that technostress in the beginning of the semester leads to a decline in the sleeping characteristics in the end of the semester, as well as bedtime procrastination.

In addition, technostress can inhibit the ability of a person to self-regulate that, in turn, prevents them from adapting to daily life and maintaining mental health (Nature Scientific Reports, 2026).

Association Between Digital Transformation and Technostress

The connection between digital transformation and technostress has been the subject of many researchers' attention in recent years. Technostress has been proposed to exist based on some aspects of technology such as complexity and uncertainty by Ragu-Nathan et al. (2008). In the field of education, it was subsequently found that learners suffer from technostress in learning due to the technology they use in the learning process (Lin & Yu, 2025).

Based on the findings of this study, it can be concluded that technostress becomes a full mediator between the relationship between Digital Taylorism Implementation and the level of work experience of students in online learning. This implies that technostress is an important mediator between the impact of digital transformation on student outcomes.

Recent findings from Pakistan validate the role of technical aspects of the technology use as one of the major factors affecting technology stress among students (Siddiqui et al., 2022). Additionally, studies have indicated that digital distractions, including the use of social media while studying, can lead to decreased attention and engagement, stress, and decreased academic success (R Discovery, 2025). Furthermore, self-regulated learning strategies are recognized as potential mitigators against digital distractions, helping students achieve academic success, even in the face of constant digital distractions (R Discovery, 2025).

Relationship Between Technostress and Perceived Stress

There has always been a positive correlation between technostress and perceived stress in university students based on empirical evidence. Technostress is a significant predictor of perceived stress and that perceived stress is related to emotional exhaustion by Buenadicha-Mateos et al. (2022). Likewise, hybrid learning requirements and digital inequalities have been found to be significant factors in the psychological mechanisms of increasing perceived stress for students in emerging economy settings (Hasan et al., 2026).

Technostress and its impact on health-related outcomes has been studied in Pakistan, and one study found technostress to be a significant predictor of bedtime procrastination and sleep quality among university students in Pakistan (Nature Scientific Reports, 2026). The results showed that technology-related stress at the start of a semester was significantly related to an increase in bed-

time procrastination and decrease in sleep quality at the end of the semester, highlighting the long-term psychological consequences of technostress.

Additionally, research indicates that technostress can contribute to reduced self-regulatory abilities, which can hinder students' ability to regulate their daily lives and ensure their psychological health (Nature Scientific Reports, 2026). This is in line with the Conservation of Resources Theory (CRT), which assumes that demands related to technology deplete students' cognitive and emotional resources and result in stress outcomes (Hobfoll, 2001).

Digital Transformation and Perceived Stress: The Mediating Role of Technostress

Although a few studies have explored the relationships between technostress and perceived stress, and between digital transformation and technostress, there is still a lack of studies that investigate the mediating effect of technostress between digital transformation and perceived stress, especially in the context of university students in developing countries. Previous research has mostly been conducted in the workplace or has only looked at the direct impact of technology on stress without looking into underlying mechanisms (Salanova et al., 2013).

However, there is increasing evidence that mediation models are relevant in understanding these relationships. Buenadicha-Mateos et al. (2022) also demonstrated the central role of perceived stress in the stress pathway, as it acts as a mediator between technostress and emotional exhaustion. Lin and Yu (2025) performed a systematic review and bibliometric analysis and developed a comprehensive model of technostress among higher-education students, which involves both predictors and outcomes. They discovered that technostress has a significant impact on several aspects of learning and performances and therefore, it is crucial to understand the mechanism.

This study follows this theme and examines the mediation of technostress in the relationship between digital transformation and the perceived stress of university students in Pakistan. Technostress is regarded as an environmental demand in accordance with the theoretical foundation of the Transactional Model of Stress and Coping (Lazarus & Folkman, 1984) and the Conservation of Resources Theory (Hobfoll, 1989, 2001), whereby the environmental demand of digital transformation will result in technostress, which will lead to a depletion of the psychological resources of the students, which will be experienced as stress. The mediation pathway has not been examined in the context of the Pakistani higher education and this study fills the gap in the literature.

Research Gap and Hypotheses

Although there is now increasing evidence of the relationship between technostress and student wellbeing, some key gaps still exist. First, most of the studies have been conducted in the workplace setting or western countries with very few studies conducted in developing countries such as Pakistan (Salanova et al., 2013; Wang et al., 2020). Second, the studies on technostress in higher education have been carried out primarily in teacher-centered studies, rather than in students (Penado Abilleira et al., 2021). Thirdly, there was a lack of academic research on the mediation role of technostress between digital transformation and perceived stress (Buenadicha-Mateos et al., 2022; Duggal et al., 2023).

The present study aims to fill up some of these gaps and the following hypotheses are tested:

H1: The digital transformation and technostress of the university students are positively correlated.

H2: University students are in a positive correlation between Technostress and Perceived stress.

H3: There is a positive relationship between digital transformation and perceived stress of university students.

H4: The relationship between digital transformation and perceived stress among university students is mediated by technostress.

Methodology

Research Design

In the present study, quantitative and cross sectional research design was used to examine the relationship between digital transformation, technostress and perceived stress among the students of university in Pakistan. A quantitative method was used because it enables variables to be measured objectively and hypotheses to be tested statistically (Creswell & Creswell, 2018). The cross-sectional design was chosen as it allows the researchers to gather data at one specific time and is practical and efficient to study relationships among variables (Saunders et al., 2019). It is a design commonly employed in educational and psychological research, and is ideal for testing mediation models (Hayes, 2018).

Participants

The students of university of Gujrat, Pakistan were the respondents of this study. The number of students in the study was 300. Convenience sampling technique was used to recruit the participants. The sample size of 300 was considered to be large enough to allow for mediation analysis according to the guidelines recommended for mediation analysis using PROCESS Macro (Hayes, 2018; Fritz & MacKinnon, 2007).

The following requirements were used for selection of participants:

- Currently enrolled as a university student
- Age between 18 and 30 years
- Actively using digital technologies for academic purposes
- Willing to participate voluntarily

Students who were not in school or who did not have access to digital devices were not included in the study.

Students from diverse academic areas (social sciences, natural sciences, engineering, business, and humanities) were included in the sample. This diversity provided a broad base of students for the results to be applied to.

Instruments

Three standardized instruments were used to measure the main variables in this study. All the instruments were conducted in the English language, which is the medium of instruction in Pakistani Universities.

Digital Transformation Scale

Digital transformation was assessed with the instrument developed and validated by Pettersson et al. (2024) called Digital Transformation Scale (DTS). This measurement tool was developed based on a Cultural-Historical Activity Theory (CHAT) perspective and specifically designed to measure digitalization as a sociocultural phenomenon in educational contexts. It consists of 17 items that are split into three different dimensions: Digitization (5 items), Digitalization (6 items) and Digital Transformation (6 items).

The Digitization dimension focuses on the use and understanding of digital tools which include items that measure the use of digital tools for planning, documenting, communicating, and finding information. The Digitalization dimension reflects changes in professional work, such as planning, analysis and collaborative discussion in teams, brought about by the use of digital technologies. The Digital Transformation dimension reflects the wider organizational and societal transformations such as improved organizational collaboration, cultural development efforts, and the use of digital tools as instruments to achieve organizational goals (Pettersson et al., 2024).

Participants rated using a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree). The three dimensions accounted for a total of 68% of the variance and the instrument showed good internal consistency with Cronbach's alpha coefficients above .87 for all dimensions (Pettersson et al., 2024). In the present study, the scale had an outstanding internal consistency, with a Cronbach's alpha coefficient of .923.

Technostress Scale

Technostress scale was used to assess technostress, which was specifically designed to measure technology-related stress for university students in technology-mediated learning situations by Wang et al. (2020). This scale is based on the Person-Environment (P-E) Fit Theory which views technostress as a result of incongruence between students' abilities and demands (Abilities-Demands misfit) and students' needs and supplies (Needs-Supplies misfit) (Wang et al., 2020).

The instrument consists of 8 items, which refer to different dimensions of Technostress. Items 1, 2, and 4 are related to Abilities-Demands (A-D) misfit, which are students' sense of being overloaded with demands from technology and the constant changes in technology. The mismatch between Needs and Supplies (N-S) is assessed in Item 3, as students feel that technology-based learning does not offer them any value for their studies. The issues of insufficient competency, perceived disadvantage of peers, social exclusion, and insufficient autonomy in learning processes are discussed in items 5-8 (Wang et al., 2020).

Answers were given on a 5-point Likert scale (0 = Strongly Disagree, 4 = Strongly Agree). The instrument has high internal consistency (Cronbach's $\alpha > .90$), good content and construct validity, and concurrent validity, and there is measurement invariance across student demographic

characteristics (gender, grade level, academic discipline) (Wang et al., 2020). Scale has been shown to be valid in a variety of cultural settings, including Italy, and has shown good test-retest reliability. The internal consistency of the scale was .869 (Cronbach's alpha) in the present study.

Perceived Stress Scale

The Perceived Stress Scale (PSS-10) developed by Cohen et al., (1983) was used to measure perceived stress. The PSS-10 is a commonly used worldwide psychological stress measurement. Scale items reflect the perceived stressfulness, unpredictability, uncontrollability and overload of life (Cohen et al., 1983).

There are 10 items that measure global perceived stress on the scale. Feelings of being nervous, being unable to control important things, confidence in handling personal problems, feeling on top of things, feeling difficulties were piling up, and ability to keep important matters under control. There are six items with negative wording (4, 5, 6, 7, 9, 10) and these will need to be reverse scored.

The answers were on a 5-point Likert scale (0 = Never; 4 = Very Often). The range of the total scores was from 0 to 40, with higher scores reflecting higher levels of perceived stress. The PSS-10 has been shown to have good psychometric properties in a variety of populations, and has established reliability and validity (Cohen et al., 1983). The scale in the present study showed good internal consistency with a Cronbach's alpha of .809.

Demographic Information

Three main instruments were used as well as providing basic demographic information such as age, gender, academic discipline and year of study. This information was utilized to describe the sample.

Procedure

Three months were used to collect data. Before starting data collection, ethical approval was obtained from the relevant departments. Students were approached with permission of faculty members. In order to achieve a wide variety of participants, the recruitment process was done in several ways. The first step was to contact faculty and send them the link to the survey in the office email lists and learning management systems. Secondly, the invitation for the survey was distributed through the groups of students on social media and WhatsApp groups.

Google Forms were used to conduct the survey online. This was selected due to its convenience for students, low cost and environmental friendliness. It also enabled efficient data management, and ensured that the participants were anonymous (Creswell & Creswell, 2018).

Participants were given an information sheet before starting the survey which explained:

- The purpose of the study
- That participation was voluntary
- That they could withdraw at any time without any consequences

- That their responses would be kept confidential and anonymous

The participants then were asked to give informed consent by clicking on a button that stated their consent to participate. There were no right or wrong answers given, and they were asked to answer in an honest way based on their personal experience.

It took about 10-15 minutes to answer the survey. Attention checks were used in the survey to ensure the quality of the data. Responses that were not complete were not included in the analysis. There were 320 responses, 20 of which were patterned responses. This left 300 valid responses.

Ethical Considerations

The study followed the ethical standards of psychologists and ethical standards for conducting research as set forth in the American Psychological Association (APA, 2017). The following ethical safeguards were put in place:

Prior to consent, all participants received clear information regarding the purpose, procedures, risks and benefits of the study.

The volunteers were informed that they were free to join the program and that they did not have to take part for any length of time or that they were unable to withdraw at any time without penalty.

No names or contact information was collected and all data was anonymized. Responses were kept safely and only given to the research team.

Data Analysis

IBM SPSS Statistics (Version 27) and the PROCESS Macro for SPSS (Version 5.0) developed by Hayes (2018) were used for data analysis. The analysis proceeded in a number of steps.

Preliminary Analysis: Missing values, outliers, and statistical assumption violations were checked. There were no missing responses in the data set, with all participants providing answers to all items. Boxplots and z-scores were used to identify outliers which were not found.

Reliability Analysis: Cronbach's alpha was used to determine the internal consistency of all three scales. The alpha values of .70 or higher were deemed acceptable as suggested by Nunnally and Bernstein (1994).

Descriptive Statistics: All the study variables were computed for mean, standard deviation, minimum and maximum values. Skewness and kurtosis were also analyzed to verify the normality of the data. The range of -2 to +2 was used as an acceptable range for parametric analyses (George & Mallery, 2010).

Correlation Analysis: Pearson correlation coefficients were used to investigate the relationships between digital transformation, technostress, and perceived stress. Correlation values of .10, .30, and .50 were interpreted as small, medium, and large effects, respectively (Cohen, 1988). The level of significance was $p < .05$.

Common Method Bias: To check whether common method bias was a concern, Harman's single-factor test was conducted. All items were entered into a principal component analysis, and the percent of variance accounted for by the first factor was analyzed. A score of less than 50% indicated that common method bias was not a problem (Podsakoff et al., 2003).

Mediation Analysis: PROCESS Macro for SPSS (Model 4; Hayes, 2018) was used to test the main hypothesis with 5,000 bootstrap samples and 95% bias-corrected confidence intervals. Model 4 is for an easy mediation, one mediator.

The following specifications were used for the model:

- Independent Variable (X): Digital Transformation (totalDTS)
- Mediator Variable (M): Technostress (totalTS)
- Dependent Variable (Y): Perceived Stress (totalPSS)

The 95% bootstrap confidence interval for the indirect effect was considered to be established if it did not include zero (Hayes, 2018). The importance of direct and total effects was also investigated.

Results

Preliminary Data Analysis

Preliminary analyses were carried out to evaluate the data quality, reliability, and assumptions before testing the hypothesized mediation model.

Missing Data

There were no missing responses (N = 300) since all participants answered all items on the questionnaire.

Reliability Analysis

Table 1: Reliability Coefficients for Study Variables

Variable	Number of Items	Cronbach's α
Digital Transformation	17	.923
Technostress	08	.869
Perceived Stress	10	.809

Cronbach's alpha was used to determine internal consistency for all three scales. All scales had reliability above .70 (Nunnally & Bernstein, 1994) as presented in Table 1, which is considered acceptable.

Descriptive Statistics

Table 2: Descriptive Statistics for Study Variables (N = 300)

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Digital Transformation	300	17	85	51.95	13.306
Technostress	300	8	40	24.93	6.797
Perceived Stress	300	0	40	21.57	7.110

The descriptive statistics of all the study variables are shown in Table 2. The mean scores (M) on digital transformation (M = 51.95, SD = 13.306), technostress (M = 24.93, SD = 6.797), and perceived stress (M = 21.57, SD = 7.110) showed moderate levels of all constructs for the participants. Responses showed moderate variation, indicated by standard deviations, which indicated that there was some variation in responses within the sample.

Normality Assessment

Table 3: Skewness and Kurtosis Values for Study Variables

Variable	Skewness	Kurtosis
Digital Transformation	.141	-.057
Technostress	-.035	-.145
Perceived Stress	-.247	.604

All study variables were checked for normality of the data distribution by looking at skewness and kurtosis values (Table 3). The skewness values were from -0.247 to 0.141 and the values for kurtosis were from -0.145 to 0.604. The range of all values was within the limits of -2 to +2, which is recommended by George and Mallery (2010), and this means that the data were approximately normally distributed. Therefore, parametric statistical analyses (Pearson correlations and mediation analysis) were considered suitable to test the study hypotheses.

Correlation Analysis

Table 4: Pearson Correlations Among Study Variables (N = 300)

Variable	1	2	3
1. Digital Transformation	1		
2. Technostress	.813**	1	
3. Perceived Stress	.617**	.575**	1

*Note: *p < .001 (2-tailed).

Pearson correlation coefficients were used to look at the relationships between digital transformation, technostress, and perceived stress (Table 4). The results showed that all the variables had significant positive correlation with each other at p < .001. More specifically, digital transformation showed a strong positive correlation with technostress (r = .813, p < .001) and a moderate positive correlation with the perceived stress (r = .617, p < .001). In addition, moderate positive relationship was found between technostress and perceived stress (r = .575, p < .001). The results showed that there is a positive correlation between digital transformation and perceived stress,

and a positive correlation between technostress and perceived stress. All of the Baron and Kenny (1986) conditions for mediation analysis were met and significant relationships between all three variables were found.

Common Method Bias

Harman's single-factor test was used to check the potential common method bias. Only a little less than 50% of the variance was accounted for by the first factor, suggesting that common method bias was not a significant problem in this study (Podsakoff et al., 2003).

Main Analysis: Mediation Model

To test the hypothesis of the mediation role of technostress between digital transformation and perceived stress, the PROCESS Macro for SPSS (Model 4; Hayes, 2018) was employed using 5,000 bootstrap samples and 95% bias corrected confidence intervals. Table 5 summarizes the results.

Table 5: Mediation Analysis Results (N = 300)

Path	Effect	SE	t	p	LLCI	ULCI
Direct Effects						
Digital Transformation → Technostress (a)	.4153	.0172	24.107	< .001	.3814	.4493
Technostress → Perceived Stress (b)	.2270	.0810	2.802	.0054	.0676	.3864
Digital Transformation → Perceived Stress (c')	.2353	.0414	5.688	< .001	.1539	.3168
Total Effect						
Digital Transformation → Perceived Stress (c)	.3296	.0290	11.363	< .001	.2725	.3867
Indirect Effect						
	Effect	BootSE			BootLLCI	BootULCI
Digital Transformation → Technostress → Perceived Stress (ab)	.0943	.0335			.0239	.1556

Note. SE = standard error; LLCI = lower-level confidence interval; ULCI = upper-level confidence interval; BootSE = bootstrap standard error; BootLLCI = bootstrap lower-level confidence interval; BootULCI = bootstrap upper-level confidence interval.

Mediation Model Summary

The overall mediation model was significant, $F(2, 297) = 97.534$, $p < .001$, explaining 39.64% of the variance in perceived stress ($R^2 = .3964$).

Path Analysis

Path A (Digital Transformation → Technostress): Digital transformation was a significant positive predictor of technostress ($B = .4153$, $SE = .0172$, $p < .001$), suggesting that increased DT was related to increased technostress.

Path B (Technostress $\rightarrow$ Perceived Stress): Technostress significantly positively predicted perceived stress ($B = .2270$, $SE = .0810$, $p = .0054$), suggesting that higher technostress was related to higher perceived stress.

Path C' (Direct Effect): Digital transformation had a significant effect on perceived stress even after removing the effect of technostress ($B = .2353$, $SE = .0414$, $p < .001$).

Indirect Effect (Mediation)

The indirect effect of digital transformation on perceived stress via technostress was positive and significant ($B = .0943$, $BootSE = .0335$, 95% CI [.0239, .1556]). The bootstrap confidence interval did not include zero, suggesting that mediation was present (Hayes, 2018).

Total Effect

Overall, digital transformation had a significant overall effect on perceived stress ($B = .3296$, $SE = .0290$, $p < .001$).

Summary of Findings

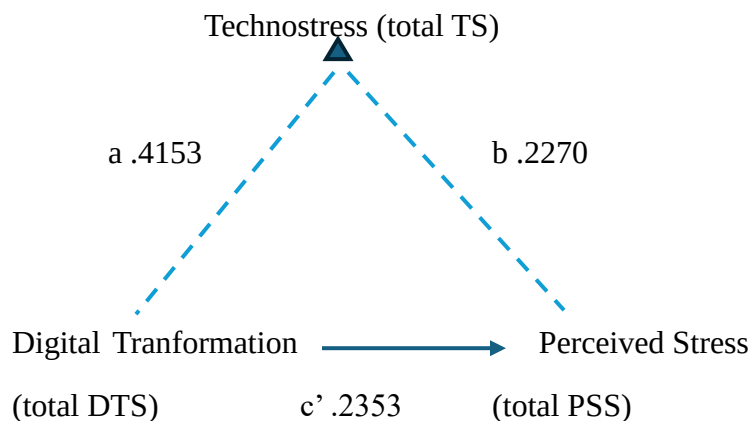
This research shows that:

1. Digital transformation is positively associated with technostress among university students.
2. Technostress is positively associated with perceived stress.
3. Technostress partially mediates the relationship between digital transformation and perceived stress.

This means that digital transformation can directly and indirectly influence the perception of stress via its effect on technostress. The indirect effect was about 28.6% of the total effect, which means that there was a significant mediation effect.

Figure

Figure 1: Mediation model with unstandardized coefficients.



Note: $a = .4153^*$, $b = .2270^*$, $c' = .2353^*$ (direct effect), $ab = .0943^*$ (indirect effect).

$^{**}p < .01$, $p < .05$.

Discussion

This study aimed to examine the mediating effect of Technostress between digital transformation and perceived stress in university students in Pakistan. The results lend empirical support to the hypothesized mediation model and provide important insights into the psychological pathways by which the impact of digital transformation on student well-being is mediated in the Pakistani higher education context.

To support Hypothesis 1, the results indicated that there is a significant and positive relationship between digital transformation and technostress in the university students. In conclusion, this finding is consistent with the previous study which has shown that digital technology integration in education contribute to students' technology-related strain (Lin & Yu, 2025; Ragu-Nathan et al., 2008). Those who feel more digital, such as relying more on the learning management system, digital platforms and technology-mediated pedagogical practice during their studies reported higher levels of technostress. The relationship may be explained using the Transactional Model of Stress and Coping (Lazarus & Folkman, 1984) where digital transformation can be considered as an environmental challenge whose appraisal by students as a threat or challenge may exceed their coping resources. As in Pakistan, technology-related technological challenges are also major factors in technology stress among students (Siddiqui et al., 2022). Studies in comparable developing country settings have validated that perceived stress levels have been found to be significantly higher when using digital inequalities as well as hybrid learning, which consequently has been reported to decrease student wellbeing (Hasan et al., 2026).

Moreover, the study revealed that technostress has a significant impact on perceived stress as hypothesized in hypothesis 2. These results are in agreement with previous studies, which showed that technostress is one of the most powerful predictors of perceived stress in university students (Buenadicha-Mateos et al., 2022; Hasan et al., 2026). The results of Buenadicha-Mateos et al. (2022) indicates that the technostress contributed significantly to predicting emotional exhaustion among higher education students and stress perception is a mediating factor. The present study expands this finding by corroborating this relationship in the Pakistani context, where students learning in a digital context face digital stress which results in increase in digital stress perceptions. This is in line with the resource-oriented theories such as Conservation of Resources Theory (Conservation of Resources Theory, 1989, 2001) that suggests that the demands of the technology cause students' cognitive and emotional resources to be depleted, thus resulting in the production of stress outcomes. Previous research among Pakistani university students has shown that technostress has a consistent and enduring effect on levels of bedtime procrastination and sleep quality (Xu et al., 2026). The problem of perceived stress has been noted in various settings among university students, for example, it was found that 54.9% of the students in Punjab, Pakistan, perceived stress as high (Chaudhry et al., 2026).

The findings also confirmed Hypothesis 3, which states that there is a direct link between digital transformation and perceived stress. In line with these studies, the fast digitalization of higher education has social and psychological side effects on students such as stress, fatigue and decreased well-being (Polat, 2025). The direct effects of digital transformation on perceived stress also indicates that students may still find themselves psychologically challenged even in the absence of technostress when using digital learning environments. Research in developing countries has revealed that hybrid learning results in a notable rise in participants' perceived stress,

leading to a decrease in the well-being of students (Hasan et al., 2026). This direct route illustrates the significance of considering both direct and indirect routes to how digital transformation influences student mental health.

First and foremost, the study validated Hypothesis 4, which states that technostress is a partial mediator between digital transformation and perceived stress. The indirect effect is positive and significant, as suggested by the bootstrap 95% confidence interval that does not include zero. This result builds on previous studies by identifying technostress as one of the most important psychological mechanisms that would contribute to the perception of stress due to digital transformation. The partial mediation suggests that there was a strong indirect effect of technostress through digital transformation on perceived stress, but digital transformation also had a direct effect on perceived stress independent of technostress. The importance of the mediating role of technostress was further demonstrated by Duggal et al. (2023) who concluded that the relationship between Digital Taylorism Implementation and students' Perceived Employability is fully mediated by technostress. The current study is an important addition in this ever-growing pool of literature by confirming the mediational pathway in the Pakistani higher education system in which digital transformation programs are increasingly gaining momentum, however, the psychological effects of such programs are largely under-researched. Studies on technostress in HE have largely concerned work environments and/or Western countries, with few studies on developing countries (Salanova et al., 2013; Wang et al., 2020). This study is intended to fill this gap in the literature by offering empirical evidence from Pakistan for the theoretical framework, which will help to improve the cross-cultural generalizability of the framework.

Implications

Theoretical Implications

The findings of this study add to the theoretical body of work in the areas of digital transformation, technostress, and student well-being. Firstly, the study combines the Transactional Model of Stress and Coping theory (Lazarus & Folkman, 1984) and Conservation of Resources Theory (Hobfoll, 1989, 2001) to provide a thorough theoretical base for the study of how Digital Transformation affects student mental well-being. The results align with the conceptualization of digital transformation as an environmental demand that triggers stress appraisal processes, and that consumes people's psychological resources, in the sense that it results in the perception of stress via the mechanism of technostress. In recent study, we combined the two models – the Conservation of Resources theory and the Job Demands-Resources model – and found that perceived stress is also an important psychological process between digital demands and student wellbeing (Hasan et al., 2026).

Second, the study opens up the application of these theoretical perspectives in the Pakistani higher education context, where digital transformation programs are growing. The findings of this study offer a more complex picture of the psychological mechanisms linking digital transformation and student well-being, highlighting technostress as a mediating factor. This fills the gap mentioned by Wang et al. (2020) that technostress has been under-researched in Higher Education especially in developing countries. However, research has indicated that digital literacy support and technostress inhibitors have a significant impact on enhancing the online learning

environment (Lin and Yu, 2025), suggesting that the mechanisms of intervention in the institution can effectively alleviate the stress caused by technology.

Third, the study offers empirical support for the mediation pathway process, which enhances the possibility of cross-cultural generalizability of the theoretical framework. The results emphasize the significance of cultural and contextual elements in the students' experience of digital transformation and technostress. A number of studies in developing country contexts have showcased that the stress and wellbeing experienced by students are greatly affected by structural barriers to digital participation such as the limited access to the internet as well as power outages and digital skills deficits (Hasan et al., 2026; Siddiqui et al., 2022). This study is an extension of this finding that demonstrates the mediation role of technostress in Pakistani higher education context where these structural hurdles are met with greater severity in rural and peripheral regions.

Practical Implications

The results of this study have several implications for practice for university administrators, policymakers, teachers and students. First, higher education institutions must acknowledge that the digital shift to higher education, far from being negative, has psychological implications for students. The institutions need to make holistic plans to reduce technostress and its impact on students' mental well-being. This includes providing sufficient technical support, training the students on digital literacies, and creating policies on technology use that take into consideration students' well-being (Lin & Yu, 2025). Technostress inhibitors, like institutional support and technical assistance, have already been proven to enhance the quality of online learning experiences and decrease technostress (Lin & Yu, 2025).

Second, teachers need to be mindful of the risk of technology-enhanced learning to cause stress and need to use technology in a pedagogy that is sensitive to student wellbeing. This encompasses giving explicit directions about the use of technology, setting flexible deadlines and designing supportive learning environments to minimize anxiety and stress. Educator awareness has been found to be important as perceived stress is linked with academic burnout, anxiety, depression and lower academic performance (Eisenberg et al, 2007). Research has been carried out in Pakistan that has shown that mental health problems are a better determinant of academic dissatisfaction than academic grades are (Chaudhry et al., 2026), which indicates the importance of including the well-being of students as an important aspect of the academic experience.

Third, in the context of national policies on digital education, the Higher Education Commission of Pakistan and other policy makers should take into consideration the psychological impacts of digital transformation. This includes providing adequate support systems, counseling services and resources to students that may have difficulties with technology-related stress or anxiety as they undergo digital transformation initiatives. It had been found that institutional support and counselling can be one way to reduce the impact of perceived stress on student well-being (Rashid et al., 2025). To mitigate the mental health risks faced by students, the educational institution ultimately needs to enhance the provision of easy-to-access mental health support, including counselling, stress-management program and stigma-reduction efforts (Chaudhry et al., 2026).

Fourth, students need to be informed of the implications of technostress and be given coping techniques to alleviate technology-related stress. This involves the development of digital literacy skills, efficiency in time management and the application of self-regulated learning strategies.

Recent studies have revealed that SRL strategies can also help to mediate distractive effects of digital devices so that students continue to achieve well in their studies (R Discovery, 2025). Research has shown that digital distractions include the use of social media during study time, can result in a reduction in attention and engagement with the content, can cause stress and can negatively impact academic performance (R Discovery, 2025). Thus, SRL and digital literacy training may help students to cope with the stress of using technology more effectively.

Fifth, the results underscore the need to consider gender differences in the experiential set of technostress. Studies in Pakistan have indicated that technostress is significantly high among male students as compared to females (Khan et al. 2025), indicating that interventions might need to be different for the two gender groups. To design effective interventions, it is vital to understand how different student groups perceive and interact with the pressures of technology and how they interact with resources in the institution. It is important to understand how different student groups perceive and interact with the pressures (of technology) and interact with the resources (of the institution) in order to design effective interventions (Araya-Ugarte et al., 2025). Universities should make support services available to all students, irrespective of gender, and plan for support to be targeted to the needs of a wide range of student groups.

Limitations and Future Research

The present study has the following limitations which are to be noted. First, because the study adopted a cross-sectional research design, the relationships among the variables cannot be considered causal. In spite of the sound theoretical base for the mediation model, longitudinal study was needed to establish the order of emergence of the relationships found in this study. Recent longitudinal research on technostress conducted in Pakistan has revealed that technostress in the beginning of an academic semester has a significant impact on the end of semester measures of bedtime procrastination and sleep quality (Xu et al., 2026), emphasizing the need for the use of longitudinal research designs to understand the long-term psychological effects of technostress. Longitudinal designs should be used in future studies to investigate the changes over time in the relationships between digital transformation, technostress and perceived stress.

Second is the use of self-report instruments, which could introduce common method bias and social desirability response. Although Harman's single factor test revealed no significant concern with common method, future research could be enriched by using objective measures of digital transformation and stress, including physiological measures of stress (e.g., heart rate variability, cortisol levels). Studies have been found that chronic stress causes autonomic dysfunction, with an overactive sympathetic system and a decrease in vagal tone, making us more susceptible to complications. (Buenadicha-Mateos et al., 2022) Such physiological assessments might create more thorough measurement of the stress response to digital transformation.

Third, the sample consisted of university students in Pakistan; thus the results may lack generalizability across other populations and settings. The study offers important insights into the higher education context in Pakistan, but further studies are needed to see if results are similar in other developing nations, and in different cultural environments. The scales in this study have been shown to produce measurement invariance results across genders, grade and major (Wang et al., 2020), indicating their applicability in various populations of students. The strength and direction of the relationships between the variables, however, may be affected by cultural and contextual

influences. Studies on Andean South America have thus suggested a regional roadmap for tackling technostress by resizing organizational settings, conducting psychometric evaluations, and developing digital wellbeing policies, positioning culturally adapted approaches as crucial to handle the issue (Araya-Ugarte et al., 2025).

Fourth, this study was limited to only specific variables such as digital transformation, technostress, and perceived stress. Future studies may include other mediators and moderators, including digital literacy, self-efficacy, social support, and coping strategies, for a more thorough understanding of how digital transformation impacts student well-being. Studies on perceived stress among students have revealed that coping mechanisms and social support have an impact on reducing the negative impacts of stress (Rashid et al., 2025). Financial strain, living situation and year of study were identified as important factors affecting perceived stress in Pakistan studies (Chaudhry et al., 2026) that need to be taken into account for future studies.

Fifth, the study's inclusion of all digital transformation experiences and technostress creators collapsed the complexity of the experiences into a single factor. Fifth, the study was not able to differentiate between various types of digital transformation experiences and technostress creators. Future studies may explore further the differential effect of, for example, technostress and perceived stress for specific components of the digital transformation (e.g., complexity of learning management system, frequency of digital assessments, requirements for online communication). Five technostress creators identified in the technostress literature are techno-overload, techno-invasion, techno-complexity, techno-insecurity and techno-uncertainty (Ragu-Nathan et al., 2008). Future studies should explore the relationship between digital transformation, perceived stress and the specific dimensions of technostress as a mediator to offer targeted feedback that can be used to develop interventions.

Conclusion

The main objective of the present study is to examine the relationship between digital transformation and perceived stress of university students in Pakistan with the focal point of technostress as a mediator. Both indirect (via technostress) and direct, the results showed that there is a positive correlation between the digital transformation and perceived stress. This partial mediation suggests that technostress is a significant psychological mechanism in the effects of students' mental health through the digital transformation.

The use of digital technologies in Pakistani universities is on an ongoing process and it is crucial to acknowledge and tackle the psychological stress that comes with the advancements. Technostress does not have to be a natural consequence, it can be reduced by providing support from the institution, digital literacy training and student-centered policies. This research provides empirical evidence from the context of a developing country and emphasizes the balance of digital transformation which protects the well-being of students and benefits from technology.

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