Frontiers in Health Informatics
ISSN-Online: 2676-7104
www.healthinformaticsjournal.com
2024; Vol 13: Issue 5
Open Access

Understanding and Exploring the Relationship Between ERP Usage and Cognitive Workload: A Gender and Age Perspective

Madhavi Dachawar[1,a] , Bharati Ainapure[1,b,*], Bhupender Singh[1,c], Nitiraj Kulkarni[1,d]
[1]Vishwakarma University, Pune-411048, India

Cite this paper as: Madhavi Dachawar , Bharati Ainapure, Bhupender Singh, Nitiraj Kulkarni(2024). Understanding and Exploring the Relationship Between ERP Usage and Cognitive Workload: A Gender and Age Perspective. *Frontiers in Health Informatics*, *13 (5) 417-430*

Abstract
This study investigates the relationship between Enterprise Resource Planning (ERP) usage and cognitive workload among higher education stakeholders, specifically focusing on gender and age differences. Understanding this relationship is important because of its implications for enhancing faculty productivity and well-being. A comprehensive literature review explores existing correlations between ERP usage and cognitive workload, highlighting gaps in the current research. The methodology involves a survey-based approach using the NASA TLX test, with data collected on various parameters including average daily ERP usage, level of psychological and physical efforts, time pressure, task completion expectations, hardness of ERP work, and stress levels. The analysis is conducted both collectively and segmented by gender and age groups. Findings reveal differences in perceptions of cognitive workload based on gender and age, with implications for ERP system design and faculty support. The study concludes with recommendations for addressing cognitive workload challenges, and all possible solutions and suggests avenues for future research.

Keywords: Enterprise Resource Planning (ERP), Cognitive Workload, Workload Perception, Stress, Productivity, System Design

1. Introduction

Technology plays an increasingly integral role in facilitating various administrative and academic tasks in today's academic landscape. One such technology that has gained widespread adoption in educational institutions is Enterprise Resource Planning (ERP) systems. These systems offer comprehensive solutions for managing diverse functions such as student records, financial management, human resources, and more. As colleges and universities continue to rely on ERP systems to streamline operations, it becomes essential to understand how their usage impacts the cognitive workload of faculty members. The cognitive workload refers to the mental effort required to complete tasks, make decisions, and process information effectively. For college faculty, who juggle multiple responsibilities ranging from teaching and research to administrative duties, the cognitive demands associated with ERP usage can significantly influence their productivity, job satisfaction, and overall well-being. Therefore, exploring the relationship between ERP usage and cognitive workload becomes paramount in ensuring the efficient functioning of academic institutions and supporting faculty members in their roles. This study focuses particularly on gender and age differences among college faculty. By examining how ERP usage affects the mental workload of faculty members across different demographic groups, we seek to identify potential areas of concern and opportunities for improvement.

2. Literature Review:

Shaul and Tauber [1] conducted an extensive review of the literature on critical success factors in ERP implementation, highlighting that ERP systems often require extensive training and adaptation to new workflows, increasing cognitive workload. They emphasized the importance of simplifying user interfaces and providing intuitive navigation to mitigate these challenges.

Kamhawi [2] examined ERP adoption in Bahrain's higher education sector, revealing that while ERP systems offer operational efficiency, the cognitive workload associated with learning and using these systems can be substantial. Faculty members reported feeling overwhelmed by the need to navigate and input data into ERP systems, which detracted from their primary academic and research duties.

Baki and Cakar [3] explored user satisfaction and performance in Turkish universities, finding that ease of use and intuitive interfaces significantly impact satisfaction. Faculty who found ERP systems difficult to use reported higher cognitive workloads and lower job satisfaction. This study also uncovered gender differences in ERP system perception, with female faculty reporting higher cognitive workloads, possibly due to differences in technological experience and additional administrative duties often assigned to women.

Pishdad and Haider [4] investigated the psychological impacts of ERP implementation on faculty in Australian universities, using the NASA Task Load Index (NASA-TLX) to measure cognitive workload. They found that older faculty experienced higher cognitive workloads, likely due to a steeper learning curve and lower familiarity with technology. This study emphasized the need for tailored training programs to reduce cognitive burdens.

Galy et al. [5] studied cognitive workload and user performance, finding that high cognitive workload negatively impacts task performance and increases error likelihood. In ERP systems, this means faculty under high cognitive strain may struggle to complete administrative tasks accurately and efficiently, affecting the institution's overall functioning.

Hart and Staveland [6], developers of the NASA-TLX, found that cognitive workload is influenced by factors such as mental demand, physical demand, temporal demand, performance, effort, and frustration. Applied to ERP usage, these factors highlight the significant mental and temporal demands placed on faculty, contributing to their overall cognitive workload.

Venkatesh et al. [7] explored gender differences in technology adoption and usage, finding that women often report higher levels of technology anxiety and lower perceived ease of use. This aligns with Baki and Cakar's findings, suggesting that female faculty may experience higher cognitive workloads with ERP systems. Women are more likely to experience stress and frustration with complex technological tasks.

Czaja and Sharit [8] reviewed the impact of aging on technology use, noting that older adults often face greater challenges in adapting to new technologies due to declines in cognitive and motor abilities. This supports Pishdad and Haider's findings of higher cognitive workloads among older faculty using ERP systems, emphasizing the need for accessible and user-friendly ERP system designs and training programs.

Tams et al. [9] examined the cognitive workload associated with ERP implementation in higher education, finding that the initial implementation phase is particularly demanding. Faculty members must adapt to new processes and integrate ERP tasks into their existing workloads, leading to increased cognitive demands.

Duggan [10] investigated faculty perceptions of ERP systems in U.S. universities, revealing that those with less technological proficiency reported higher cognitive workloads. The study suggested that continuous support and training could alleviate some of these burdens, particularly for faculty less familiar with technology.

Salmeron and Lopez [11] studied the impact of ERP systems on academic staff's workload and stress levels in Spanish universities. They found that while ERP systems streamlined many administrative processes, they also introduced new stressors related to system reliability and user interface complexity.

Nicolaou and Bhattacharya [12] explored the post-implementation challenges of ERP systems in higher education, emphasizing the ongoing cognitive demands placed on users. They found that the complexity of maintaining and updating ERP systems requires continuous learning and adaptation, which can be cognitively taxing for faculty members.

Aladwani [13] examined the role of user training and support in reducing cognitive workload associated with ERP systems. The study found that targeted training programs significantly alleviate cognitive stress by improving user competence and confidence in navigating ERP systems.

Seddon et al. [14] studied ERP system success and its relationship with cognitive workload, highlighting that successful ERP implementations are those that consider the user's cognitive load. They suggested that reducing system complexity and providing robust support structures are crucial for minimizing cognitive demands on faculty.

Chou et al. [15] investigated the impact of ERP systems on faculty productivity and workload in Taiwanese universities. They found that while ERP systems improved overall productivity, the initial cognitive workload during the learning phase was substantial. Continuous support and simplified interfaces were recommended to mitigate these effects.

Osei-Bryson and Ko [16] analyzed the cognitive workload associated with ERP system usage in African universities, finding that faculty members often experienced high levels of stress and mental fatigue. The study recommended culturally tailored training programs to address specific user needs and reduce cognitive strain.

Ifinedo [17] explored the effects of ERP system customization on cognitive workload in Canadian universities. The findings indicated that excessive customization increased cognitive demands, as faculty members had to continuously adapt to changes. Standardized processes and consistent training were suggested to reduce cognitive load.

Bradley [18] examined ERP system usability and its impact on cognitive workload among faculty in UK universities. The study found that poor usability significantly increased cognitive workload, leading to higher levels of frustration and lower job satisfaction. The research emphasized the importance of user-centered design in ERP systems.

Baker et al. [19] investigated the role of ERP system integration in cognitive workload among faculty in Australian universities. They found that well-integrated ERP systems reduced cognitive workload by providing seamless data flow and reducing redundant tasks. However, poor integration led to higher cognitive demands and stress.

Askenäs and Westelius [20] studied the impact of ERP system upgrades on cognitive workload in Swedish universities. They found that frequent upgrades often disrupted workflow and increased cognitive demands on faculty. The study recommended careful planning and user involvement in the upgrade process to minimize cognitive strain.

3. Methodology

Cognitive workload, within the context of this study, refers to the mental effort and resources required by higher educational stakeholders when engaging with ERP systems. It encompasses various cognitive processes, including but not limited to, decision-making, problem-solving, information processing, and task completion. Understanding cognitive workload is essential as it sheds light on the cognitive demands imposed on stakeholders as they interact with ERP systems in their daily work activities.

3.1 Need for Cognitive Workload Analysis:

The need to assess cognitive workload among higher education stakeholders in the context of ERP systems arises from several key factors.

Enhanced Understanding of Stakeholders Experience: Understanding the cognitive workload experienced by stakeholders while using ERP systems provides valuable insights into their daily work experiences. By assessing the mental effort required for tasks such as accessing student records, managing course schedules, or submitting grades, institutions can better understand stakeholders' challenges in their administrative and academic roles.

Optimization of ERP Systems: Insights into cognitive workload can inform the design and optimization of ERP systems to better support faculty workflows. By identifying areas of high cognitive demand, such as complex user interfaces or cumbersome data entry processes, institutions can streamline system functionalities to reduce mental strain and enhance user experience. This, in turn, can lead to increased efficiency, productivity, and satisfaction among faculty users.

Faculty Training and Support: Assessing cognitive workload can also guide faculty training and support initiatives aimed at improving ERP proficiency and reducing job-related stress. By identifying areas where faculty may struggle or feel overwhelmed, institutions can tailor training programs to address specific needs and provide targeted support resources. This proactive approach not only empowers faculty to navigate ERP systems more effectively but also fosters a culture of continuous learning and professional development.

Promotion of Faculty Well-being: High levels of cognitive workload can contribute to faculty burnout, stress, and dissatisfaction, ultimately impacting overall well-being and job satisfaction. By recognizing and addressing factors contributing to cognitive strain, such as system complexity, workload expectations, or inadequate support resources, institutions can promote a healthier work environment for faculty. This includes implementing strategies to manage workload demands, foster work-life balance, and prioritize faculty mental health and wellness.[25,26]

3.2 Test Used

This study uses the NASA Task Load Index (NASA-TLX) test which is a widely used tool for assessing cognitive workload in various domains, including aerospace, healthcare, and education. Developed by NASA Ames Research Center, the NASA-TLX provides a multidimensional assessment of cognitive workload based on subjective ratings from individuals performing tasks.[24]

The NASA-TLX comprises six dimensions:

1. Mental Demand: The perceived level of mental effort required to accomplish the task.
2. Physical Demand: The perceived level of physical effort or exertion required during task performance.
3. Temporal Demand: The perceived time pressure or urgency associated with completing the task.
4. Performance: The individual's perception of their own performance while carrying out the task.
5. Effort: The overall level of effort expended to accomplish the task.
6. Frustration: The degree of annoyance, dissatisfaction, or stress experienced during task execution.

Participants in the survey rate each dimension on a scale from 0 to 10, with higher scores indicating greater perceived workload. After completing a task or set of tasks, participants provide ratings for each dimension, and the scores are averaged to calculate an overall workload score.

The NASA-TLX offers several advantages, including its versatility, ease of administration, and ability to capture subjective experiences of workload across multiple dimensions. It provides valuable insights into the cognitive demands associated with different tasks and can inform the design of systems, procedures, and environments to optimize workload distribution and task performance.[22][23]

3.3 Survey Methodology:

The survey conducted for this study aimed to gather comprehensive insights into the cognitive workload experienced by stakeholders using ERP systems in higher education institutions. Figure 1 shows the survey instrument preparation flow. The primary focus was understanding the psychological and physical efforts required, the time pressure experienced, satisfaction with task completion, and overall stress levels. This information is crucial for identifying potential areas of improvement in ERP systems to support stakeholders better. Table 1 gives information about survey parameters.

Table 1: Survey Parameters

Parameter	Details
Method	Online survey
Technique	Quantitative approach
Questions Format	Likert scale (1-10), multiple-choice questions
Sampling	Random sampling of faculty members
Demographic Information	Gender, Age
ERP Usage Information	Daily hours of ERP usage, Preferred language
Psychological Efforts	Level of psychological efforts required (1-10 scale)

Parameter	Details
Physical Efforts	Level of physical efforts required (1-10 scale)
Time Pressure	Level of time pressure experienced (1-10 scale)
Task Completion Satisfaction	Satisfaction with task completion as per expectations (1-10 scale)
Work Effort	Amount of effort required to complete tasks (1-10 scale)
Stress Levels	Stress levels while working on ERP (1-10 scale)
Combination questions on each parameter	To find out the correlation between parameters and its impact

The survey utilized a comprehensive online technique to capture detailed insights from stakeholders regarding their experiences with ERP systems. By employing a quantitative approach, the survey ensured a structured understanding of the cognitive workload associated with ERP usage. Questions were formatted primarily using Likert scales ranging from 1 to 10 and multiple-choice options to quantify responses effectively. Participants were selected using random sampling, ensuring a representative sample of faculty members. The survey collected demographic information such as gender and age, as well as specific details on ERP usage, including the average daily hours of use and preferred languages.
Key aspects of the survey included assessments of the psychological and physical efforts required to use the ERP system, the level of time pressure experienced, and the satisfaction with task completion. Additionally, the survey evaluated the overall work effort and stress levels while working on the ERP system. It also examined user experience, focusing on comfort and satisfaction with the ERP system, as well as system performance and technical requirements. Non-technical aspects were considered, such as the need for training and education, support, and management involvement. This detailed data collection aimed to identify areas where ERP systems can be improved to reduce cognitive workload and enhance the overall effectiveness and user satisfaction for faculty members in higher education institutions.[21]
The survey will include questions designed to capture faculty perceptions of cognitive workload and the impact of system improvements on their work experiences. Sample survey questions may include:

1. On a scale of 1 to 10, please rate the level of mental effort required to complete tasks within the ERP system.
2. How often do you encounter physical strain or discomfort when using the ERP system? (Rarely/Sometimes/Often)
3. To what extent do time constraints impact your ability to complete tasks within the ERP system? (Not at all/To some extent/Significantly)
4. How would you rate the overall complexity of tasks performed within the ERP system? (Low/Moderate/High)

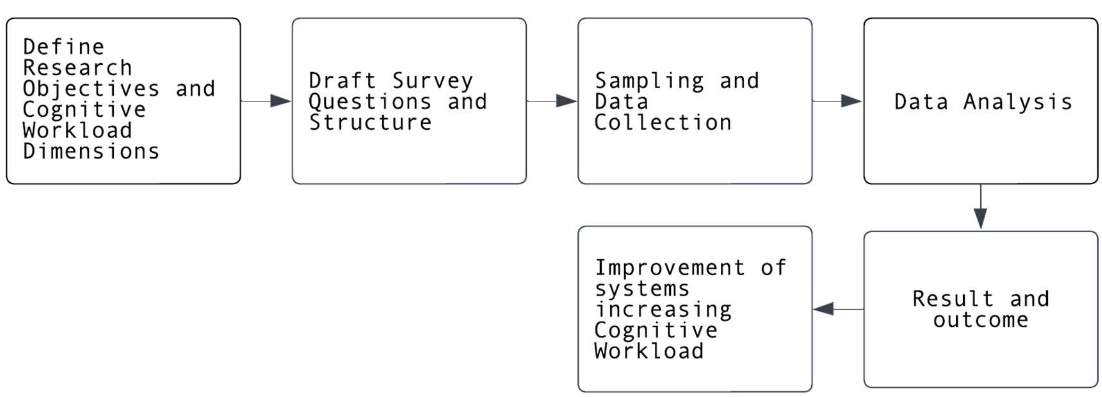

Figure 1. Survey Instrument Preparation Flow

We aim to provide insights into the impact of system improvements on cognitive workload among higher education stakeholders. By identifying areas where system enhancements may lead to increased cognitive workload, institutions can implement targeted interventions to mitigate these challenges and improve faculty work experiences.

4. Result

The general analysis mentioned in Table 2 of the data revealed several key insights into the cognitive workload experienced by higher education stakeholders using Enterprise Resource Planning (ERP) systems. Firstly, it was evident that faculty members dedicate a significant portion of their work time to ERP tasks, indicating the importance of these systems in their daily activities. In terms of cognitive demands, respondents reported a moderate level of psychological efforts required to complete tasks within the ERP system. This suggests that users engage in various cognitive processes such as decision-making, problem-solving, and information retrieval while navigating the ERP interface.It also indicated a notable perception of physical efforts associated with ERP usage, with respondents reporting tasks within the system as laborious. This highlights the physical strain experienced by users, potentially impacting their comfort and efficiency during system interaction. Respondents expressed a moderate level of time pressure while working on ERP tasks. This suggests that users may feel compelled to complete tasks within a certain timeframe, potentially influencing their decision-making and task prioritization within the system. Despite these challenges, respondents reported a moderate level of satisfaction with task completion within the ERP environment. This indicates that while users may face cognitive and physical demands, they generally perceive their task outcomes to meet organizational expectations. While respondents reported a moderate level of stress associated with ERP usage, the majority indicated feeling much relaxed while working on tasks within the system. This suggests that while users may experience stressors during system interaction, they also find moments of relaxation and comfort within the ERP environment.

Table 2. Summary of all analysis

Parameter	Likert Average	Summary
Average Daily Hours Spent on ERP	1.2 hours	Users spend approximately 1.2 hours daily on ERP tasks.
Level of Psychological Efforts Needed	5.39	Moderate level of psychological efforts required.
Level of Physical Efforts Needed	5.63	50% of respondents perceive ERP work as laborious.
Level of Time Pressure	5.27	Moderate level of time pressure experienced.
Level of Completing Task as per Expectations	5.04	Moderate satisfaction with task completion as per organizational expectations.
Level of Hardness of ERP Work	5.63	Moderate to high perceived hardness of ERP tasks.
Stress Level while Working on ERP	5.07	Moderate level of stress; majority feel much relaxed during ERP tasks.

The correlation heatmap in Figure 2 reveals several noteworthy relationships among the cognitive workload metrics. Psychological Effort exhibited a moderate positive correlation with Physical Effort ($r = 0.55$), indicating that users who exert more psychological effort also tend to exert more physical effort. A similar moderate correlation was observed between Psychological Effort and Time Pressure ($r = 0.63$), suggesting that higher psychological demands are associated with increased time constraints.

Physical Effort showed a strong positive correlation with Time Pressure ($r = 0.82$), indicating a significant overlap between these two metrics. Users experiencing high physical demands also face substantial time pressure. Additionally, Physical Effort correlated moderately with Work Difficulty ($r = 0.67$) and Stress Level ($r = 0.46$), highlighting the impact of physical demands on perceived task difficulty and stress.

Time Pressure, in turn, displayed a strong correlation with Work Difficulty (r = 0.68) and a moderate correlation with Stress Level (r = 0.40), indicating that tasks perceived as time-pressured are also seen as more difficult and stressful. Task Completion Success had relatively weak correlations with the other metrics, including Psychological Effort (r = 0.20), Physical Effort (r = 0.16), and Time Pressure (r = 0.18), suggesting that successful task completion may be influenced by factors outside the measured cognitive workload metrics.

Work Difficulty was moderately correlated with Stress Level (r = 0.54), indicating that increased task difficulty is associated with higher stress levels.

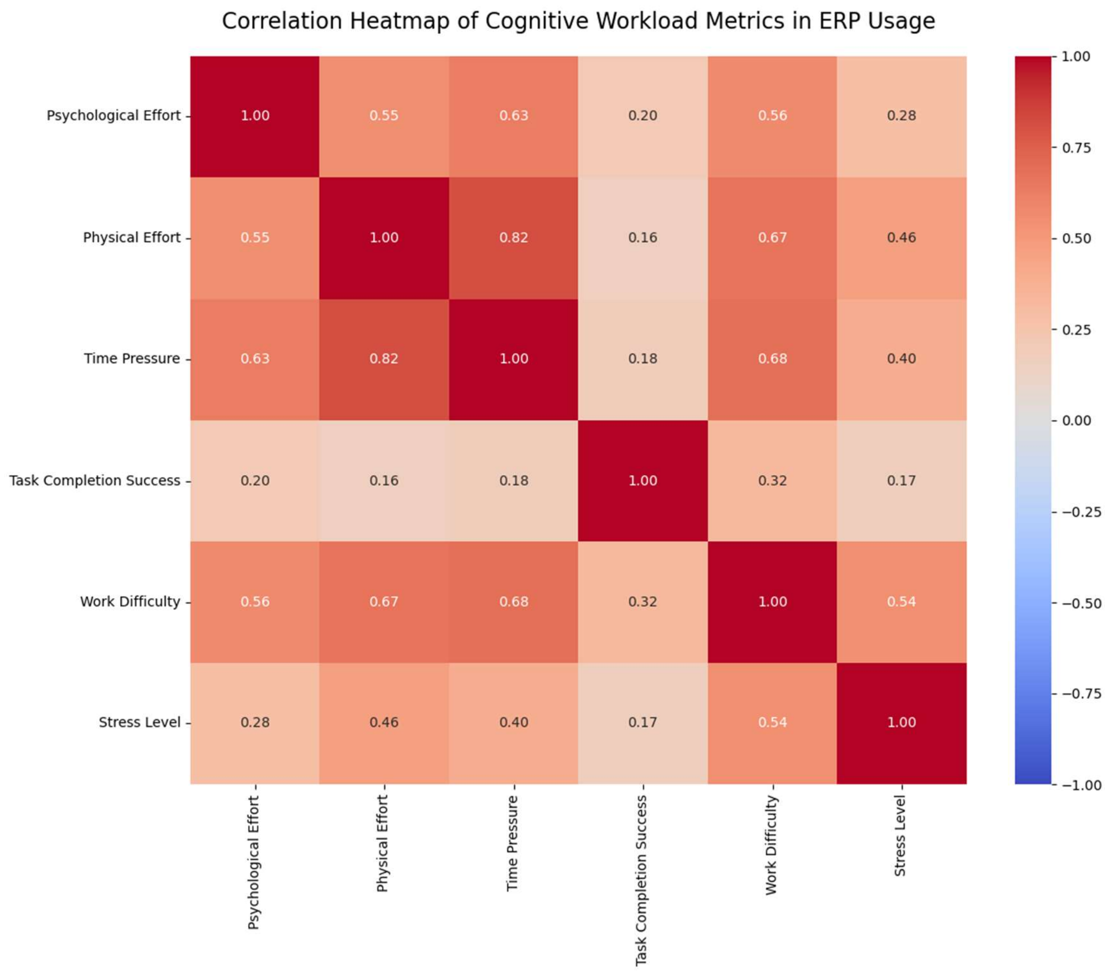

Figure 2: Correlation heatmap of Cognitive Workload Matrix in ERP Usage

4.1 Comparative Analysis Male and Female Respondents

In comparing the responses between male and female participants, several notable observations emerge regarding their experiences with Enterprise Resource Planning (ERP) systems. Table 3 gives the analysis based on gender. Firstly, while both genders spend a significant amount of time on ERP tasks, female respondents tend to allocate slightly more time compared to their male counterparts, though the difference is marginal. Interestingly, male respondents indicate a higher need for psychological efforts when performing ERP tasks, suggesting that they perceive these tasks as more mentally demanding than female respondents. However, both male and female respondents report similar levels of physical effort required for ERP tasks, indicating a common perception of the physical strain associated with system interaction. Regarding time pressure, male respondents report experiencing higher levels compared to female respondents, suggesting that they may feel more pressured to complete tasks within a certain timeframe. Moreover, male respondents perceive their task completion as slightly higher than female respondents, indicating a nuanced difference in their satisfaction with task outcomes. However, both genders perceive similar levels of hardness in ERP tasks, suggesting a shared perception of the overall difficulty of tasks within the system. In terms of stress levels, minimal differences are observed between male and female respondents, with both genders reporting relatively low levels of stress while working on ERP tasks. This finding suggests that while there may be variations in perceived psychological efforts and time pressure between male and female respondents, they generally experience similar levels of stress during system interaction.

Table 3. Comparative Analysis of Males and Females

Parameter	Female Respondents	Male Respondents	Observation
Average Daily Hours Spent on ERP	1.2 hours	1.1 hours	Female respondents spend slightly more time on ERP tasks compared to male respondents.
Level of Psychological Efforts Needed	5.11	6	Male respondents indicate a higher need for psychological efforts compared to female respondents.
Level of Physical Efforts Needed	5.6	5.6	Both male and female respondents perceive similar levels of physical effort required for ERP tasks.
Level of Time Pressure	5.5	5.9	Male respondents report higher time pressure compared to female respondents.
Level of Completing Task as per Expectations	4.9	5.3	Male respondents perceive their task completion to be slightly higher than female respondents.
Level of Hardness of ERP Work	5.2	5.3	Both genders perceive similar levels of hardness in ERP tasks.
Stress Level while Working on ERP	5.0	5.3	Minimal differences were observed in stress levels between male and female respondents.

4.2 Age Segregation Cognitive Workload Analysis

The age-segregated data analysis given in Table 4 and Figure 3 uncovers patterns in the cognitive workload of respondents across varying stages of adulthood. While the average daily hours dedicated to ERP tasks show minimal divergence among age groups, the escalation of psychological efforts with advancing age emerges as a compelling trend. The data reveals that individuals in the age groups 25-35, 36-45, and 46-59 report similarly high scores across all metrics, indicating they spend more hours on ERP systems and experience greater psychological and physical effort, time pressure, and work difficulty compared to other age groups. In contrast, those under 25 and over 60 show lower scores in all categories, suggesting that these age groups engage less with ERP systems and face fewer associated challenges. This pattern highlights that middle-aged users experience higher demands and challenges related to ERP usage.

This inequality highlights the intricate interplay between age, job role, and ERP task complexity, underscoring the need for tailored support mechanisms to address the evolving needs of ERP users across different life stages. Furthermore, the consistent stress levels reported across age groups suggest that factors beyond chronological age, such as job role or organizational culture, may exert a more pronounced influence on individuals' psychological well-being in the context of ERP usage. These multifaceted observations emphasize the importance of holistic approaches to understanding and accommodating age-related variations in cognitive workload within ERP environments, with implications for system design, training protocols, and organizational support frameworks.

Table 4. Comparative Analysis between different age groups

Parameter	**Age Group 25-35**	**Age Group 36-45**	**Age Group 46-59**	**Observations**
Average Daily Hours Spent on ERP	1.21 hours	1.16 hours	1.28 hours	No significant variation observed in the average daily hours spent on ERP tasks across age groups.
Level of Psychological Efforts Needed	5.2	5.41	6.14	The level of psychological efforts needed increases with age, with the highest average score observed in the 46-59 age group.
Level of Physical Efforts Needed	5.7	5.35	6.28	Similar levels of physical efforts needed are reported across age groups, with slightly higher scores observed in the 46-59 age group.
Level of Time Pressure	5.69	5.61	5.85	Age group 46-59 reports the highest level of time pressure, indicating a greater sense of urgency in completing ERP tasks among older respondents.
Level of Completing Task as per Expectations	4.94	5.45	4.85	Age group 36-45 reports the highest level of task completion satisfaction, while age group 46-59 reports the lowest.
Level of Hardness of ERP Work	5.42	4.96	5.57	Age group 36-45 reports the lowest level of perceived hardness in ERP tasks, while age group 46-59 reports the highest.
Stress Level while Working on ERP	5.17	4.96	5.07	No significant variation observed in stress levels across age groups, with relatively similar scores reported.

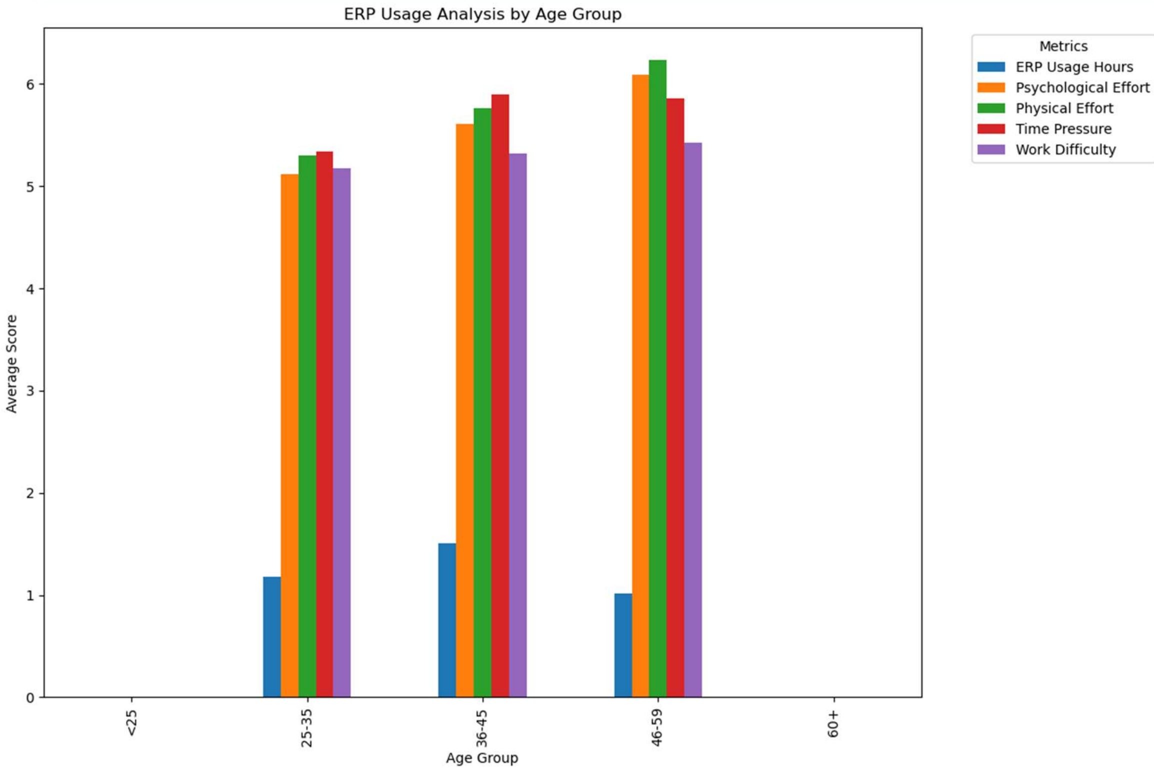

Figure 3: ERP Usage by Age Group

5. Discussion: Reducing Cognitive Workload Possible Solutions

The analysis of cognitive workload (CW) in the context of ERP usage across gender and age groups highlights several critical insights that must be considered to reduce the workload and improve system design, training, and user support. By focusing on specific gender- and age-related challenges, we can address the unique needs of faculty members, enhancing both system usability and overall well-being.

1. Gender-Based Workload Differences

The study reveals that male faculty members perceive ERP tasks as more mentally demanding, as indicated by a higher psychological effort score of 6.0 compared to 5.11 for females. However, female respondents tend to spend slightly more time using ERP systems daily (1.2 hours compared to 1.1 hours for males), suggesting that women may take longer to complete tasks, potentially due to additional administrative responsibilities. The physical efforts required to navigate ERP systems were reported as similar by both genders, which may reflect the system's overall demands, regardless of user demographic.

These findings are critical as they highlight the nuanced nature of gender-based cognitive workload. Although men report higher mental strain, women's longer engagement with the system likely reflects the cumulative burden of managing both academic and administrative responsibilities. This discrepancy suggests that while men may struggle with the complexity of ERP tasks, women face a broader set of challenges due to time spent on task completion.

2. Age-Based Cognitive Workload Variations

The age-segregated analysis indicates that cognitive workload increases significantly for the 46-59 age group, with this demographic reporting the highest psychological and physical efforts, time pressure, and ERP task difficulty. This suggests that middle-aged faculty members face more challenges in adapting to and using ERP systems, likely due to a combination of increased responsibilities and a steeper learning curve for digital technologies. By contrast, younger faculty (under 35) and older faculty (60+) reported lower levels of cognitive strain, indicating that familiarity with technology and reduced administrative responsibilities play a role in mitigating cognitive workload.

Middle-aged faculty members (46-59) face the most significant challenges in adapting to ERP systems, indicating the need for age-specific interventions. These could include adaptive interfaces that simplify navigation based on user experience, reducing cognitive strain. Moreover, age-tailored training programs that offer more hands-on, gradual learning approaches can help middle-aged users become more comfortable with ERP functionalities. On the other hand, younger users, who are typically more familiar with technology, may benefit from advanced, gamified training modules that emphasize efficiency and productivity.

For the oldest faculty group (60+), who reported lower psychological and physical efforts, institutions could implement simplified interfaces or provide on-demand support systems to reduce any remaining cognitive burden. This might include in-system pop-up guides or voice-activated assistance to make ERP usage smoother and more intuitive.

3. Inter-Parameter Correlation and Cognitive Load Factors

The correlation heatmap (refer to Figure 2) demonstrates significant relationships between different dimensions of cognitive workload. Psychological and physical effort are moderately correlated (r = 0.55), indicating that as psychological demands increase, so do the physical strains associated with ERP tasks. Time pressure also shows strong correlations with physical effort (r = 0.82) and task difficulty (r = 0.68), suggesting that faculty members perceive tasks as more physically and mentally demanding when they face tight deadlines.

The relatively weak correlation between task completion success and other cognitive workload metrics, including psychological (r = 0.20) and physical effort (r = 0.16), suggests that while faculty members may find ERP tasks demanding, this does not significantly impact their ability to complete tasks successfully. However, the increasing cognitive load could lead to long-term stress and burnout if not addressed through systemic changes.

Table 5 presents various potential solutions to mitigate workload effects, taking into account the target group and the specific benefits they gain from utilizing each solution.

Table 5. e Solutions to Address Cognitive Workload in ERP System Usage

Solution	Description	Target Group	Benefits
Personalized Task Automation	AI-powered tools to automate repetitive tasks such as data entry, grading, and scheduling, reducing manual input and cognitive strain.	Faculty with heavy administrative duties, particularly female faculty spend more time on ERP tasks.	Reduces time spent on routine tasks, allowing faculty to focus on core academic work; provides real-time feedback, lowering cognitive effort in task management.
Adaptive User Interfaces (UI)	Customizable interfaces that adjust complexity based on user expertise. Advanced features for tech-savvy users; simplified navigation and larger icons for older or less experienced users.	Middle-aged and older faculty, faculty with lower technological proficiency.	Reduces mental load by offering personalized, user-friendly interfaces; helps users navigate tasks based on their comfort level, reducing both psychological and physical effort.
Gamified Learning and Training	Interactive training modules with gamification elements (badges, milestones, rewards). Self-paced workshops for hands-on learning.	Younger, tech-savvy faculty for advanced features; older or less-experienced users for self-paced, gradual learning.	Makes learning fun and engaging; reduces the mental strain of learning complex systems; and enables faster adaptation for younger faculty while easing the learning curve for older

Solution	Description	Target Group	Benefits
			users.
Collaborative Learning Networks	Peer mentoring systems and collaborative learning platforms where experienced faculty can share best practices and ERP tips with less-experienced users.	Faculty of all experience levels, especially those struggling with ERP usage.	Encourages peer-to-peer support, reducing cognitive workload through collective problem-solving and shared expertise.
Contextual Real-Time Assistance	Real-time guidance tools such as tooltips, pop-up guides, and voice-activated assistance offer help when users are struggling with a task.	Middle-aged, older, or less tech-savvy users may need more assistance while completing tasks.	Reduces cognitive strain by offering immediate assistance during task completion; ensures smoother workflow, as users do not have to search for help externally.
On-Demand Tutorials and Assistance	Integrated on-demand video tutorials, step-by-step guides, and help features within the ERP system for users to access anytime.	Older faculty and users who require more support during ERP use.	Reduces cognitive effort in learning and task execution; provides continuous support without needing to leave the task or seek external help, lowering stress and increasing confidence in system navigation.
AI-Driven Cognitive Load Monitoring	AI-based monitoring systems that track cognitive load during ERP usage and suggest break times or task modifications to prevent overload.	Faculty facing high time pressure and task difficulty, particularly middle-aged faculty.	Helps prevent burnout by suggesting rest or simplified workflows; monitors real-time cognitive workload and provides adaptive responses to reduce stress and physical and mental strain.

Conclusion:

Exploration into the cognitive workload experienced by higher education stakeholders within Enterprise Resource Planning (ERP) systems has provided valuable insights into the workings of managing cognitive demands in educational settings. From demographic analyses to comparative assessments and proposed strategies, each facet of our investigation contributes to a deeper understanding of the challenges and opportunities associated with cognitive workload management. Through demographic analysis, we uncovered variations in cognitive workload across gender, age groups, and job roles, highlighting the importance of tailored approaches to address diverse cognitive needs effectively. The comparative analysis between male and female respondents highlighted gender-based differences in perceived cognitive demands, emphasizing the significance of gender-sensitive design and support mechanisms within ERP systems. Similarly, age-segregated data analysis illuminated the evolving cognitive needs of faculty members at different stages of their careers, emphasizing the importance of age-appropriate training, interface design, and support resources to accommodate changing cognitive demands effectively. By recognizing the unique challenges faced by faculty members across gender and age cohorts, educational institutions can implement targeted interventions to enhance user experiences and reduce cognitive strain. Furthermore, our exploration into strategies for reducing cognitive workload offered actionable insights into optimizing ERP systems, streamlining workflows, and fostering a supportive academic environment conducive to cognitive well-being. Personalized training, simplified user interfaces, automation, contextual assistance, and collaborative learning initiatives emerged as key strategies to alleviate cognitive burden and enhance productivity among faculty members.

Our findings underscore the critical importance of prioritizing cognitive workload management in educational environments to support faculty well-being, optimize workflow efficiency, and promote academic excellence. By leveraging demographic insights, comparative analyses, and evidence-based strategies, educational institutions can cultivate an ERP ecosystem that empowers faculty members to thrive in their roles while minimizing cognitive strain and maximizing the value derived from educational resources.

References:

1. Shaul, L., & Tauber, D. (2013). "Critical success factors in enterprise resource planning systems: A review of the literature". *Journal of Enterprise Information Management, 26*(1), 10-27.
2. Kamhawi, E. M. (2008). "Enterprise resource-planning systems adoption in Bahrain: Motives, benefits, and barriers". *Journal of Enterprise Information Management, 21*(3), 310-334.
3. Baki, R., & Cakar, K. (2005). "Determining the ERP user satisfaction by using the model of DeLone and McLean". *Journal of Enterprise Information Management, 18*(1), 51-55.
4. Pishdad, A., & Haider, A. (2014). "ERP institutionalization and the influence of external factors: A comparison of UK and USA". *Journal of Enterprise Information Management, 27*(3), 321-345.
5. Galy, E., Cariou, T., & Mélan, C. (2012). "What is the relationship between mental workload factors and cognitive performance?". *Work: A Journal of Prevention, Assessment, and Rehabilitation, 41*(S1), 5023-5030.
6. Hart, S. G., & Staveland, L. E. (1988). "Development of NASA-TLX (Task Load Index): Results of empirical and theoretical research". *Advances in Psychology, 52*, 139-183.
7. Venkatesh, V., Morris, M. G., & Ackerman, P. L. (2000). "A longitudinal field investigation of gender differences in individual technology adoption decision-making processes". *Organizational Behavior and Human Decision Processes, 83*(1), 33-60.
8. Czaja, S. J., & Sharit, J. (1998). "Age differences in attitudes toward computers". *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 53*(5), P329-P340.
9. Tams, S., Hill, K., & Díaz Andrade, A. (2014). "Explaining the impact of electronic communication on psychological contract fulfillment and employee turnover". *Journal of Enterprise Information Management, 27*(4), 439-454.
10. Duggan, E. W. (2002). "Generative systemic structural activity modeling: Analyzing the dynamics of ERP implementation". *Information Resources Management Journal, 15*(1), 25-36.
11. Salmeron, J. L., & Lopez, C. (2010). "A multi-criteria approach for risks assessment in ERP maintenance". *Journal of Systems and Software, 83*(10), 1941-1953.
12. Nicolaou, A. I., & Bhattacharya, S. (2006). "Organizational performance effects of ERP systems usage: The impact of post-implementation changes". *International Journal of Accounting Information Systems, 7*(1), 18-35.
13. Aladwani, A. M. (2001). "Change management strategies for successful ERP implementation". *Business Process Management Journal, 7*(3), 266-275.
14. Seddon, P. B., Calvert, C., & Yang, S. (2010). "A multi-project model of key factors affecting organizational benefits from enterprise systems". *MIS Quarterly, 34*(2), 305-328.
15. Chou, S. W., Lin, C., & Huang, L. (2004). "Understanding knowledge management system usage antecedents: An integration of social cognitive theory and task technology fit". *Information & Management, 41*(6), 695-706.
16. Osei-Bryson, K. M., & Ko, M. (2004). "Exploring the relationship between information technology investments and firm performance using regression splines analysis". *Information & Management, 42*(1), 1-13.
17. Ifinedo, P. (2011). "Examining the influences of external expertise and in-house computer/IT knowledge on ERP system success". *Journal of Systems and Software, 84*(12), 2065-2078.
18. Bradley, J. (2008). "Management based critical success factors in the implementation of enterprise resource planning systems". *International Journal of Accounting Information Systems, 9*(3), 175-200.

19. Baker, T., Al-Gahtani, S. S., & Hubona, G. S. (2007). "The effects of gender and age on new technology implementation in a developing country: Testing the theory of planned behavior (TPB)". *Information Technology & People, 20*(4), 352-375.
20. Askenäs, L., & Westelius, A. (2000). "Five roles of an information system: A social constructionist approach to analyzing the use of ERP systems". *International Journal of Human-Computer Interaction, 14*(1), 95-112.
21. Dachawar, Madhavi; Ainapure, Bharati; Kulkarni, Nitiraj (2024), "Dataset: Cognitive Workload Analysis in Enterprise Resource Planning ", Mendeley Data, V1,
22. Devos H, Gustafson K, Ahmadnezhad P, Liao K, Mahnken JD, Brooks WM, Burns JM. Psychometric Properties of NASA-TLX and Index of Cognitive Activity as Measures of Cognitive Workload in Older Adults. Brain Sci. 2020 Dec 16;10(12):994.
23. Nikulin, C., Lopez, G., Piñonez, E. *et al.* NASA-TLX for predictability and measurability of instructional design models: case study in design methods. *Education Tech Research Dev* **67**, 467–493 (2019).
24. Hart, S. G. (2006). Nasa-Task Load Index (NASA-TLX); 20 Years Later. Proceedings of the Human Factors and Ergonomics Society Annual Meeting, 50(9), 904-908.