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Ergonomic Practices and Banking Employee Performance: A Sequential Explanatory Approach

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ABSTRACT

Using the sequential explanatory method, this study sheds light on the influence of ergonomics practices on the performance of banking employees. Data from 267 banking employees were collected and analyzed Via PLS-SEM, and using Heidegger's interpretative philosophy, a semi-structured interview was conducted purposively with seven frontline employees. The study found that cognitive and organizational ergonomics significantly predict employee performance, while environmental and physical ergonomics were not supported. Thematic analysis identified four major themes: physical ergonomics and comfort, environmental ergonomics and workspace design, cognitive ergonomics and mental workload, and organizational ergonomics and support systems. This study highlights the importance of cognitive and organizational ergonomics, challenging traditional ergonomic models and offering practical recommendations for optimizing work environments in customer-focused and knowledge-intensive industries.

Keywords: Banks, cognitive ergonomics, employee performance, environmental ergonomics, physical ergonomics, organizational ergonomics

INTRODUCTION

The International Ergonomics Association defines ergonomics as a scientific discipline focused on understanding interactions among humans and other system elements (International Ergonomics Association, 2018). Ergonomics, as described by Guastello (2023), applies theories, principles, data, and techniques to enhance human well-being and overall system efficiency. Workplace ergonomics, a multidisciplinary field, considers factors influencing worker comfort and health, such as illumination, noise, temperature, and workstation design (Bolis et al., 2023; Merino-Salazar, 2017). This concept optimizes individuals' interaction and work environment (Deshpande, 2013).

What factors contribute to a productive and engaged workforce? One crucial aspect often overlooked is ergonomics, the science of designing the workplace to fit the employees. Ergonomics goes beyond just comfortable chairs; it encompasses four dimensions (i.e., physical, cognitive, environmental, and organizational), which create a holistic work environment that optimizes employee well-being and performance (Agrawal et al., 2025).

Technological advances and business environment changes have made occupational stress a significant health issue (Travers & Cooper, 2024). Insufficient attention to the impact of work processes and technologies has led to harmful effects on workers and unmet organizational goals for employee efficiency and productivity. In addition, the office environment can be viewed as a dynamic sociophysical system, distinct from the physical setting or organizational unit (Colenberg et al., 2021), emphasizing the interdependence between designed environments, technology, work activities, and the social system comprising people, their values, relationships, and corporate culture (Baobeid et al., 2021).

Companies are increasingly prioritizing cost reduction through downsizing and risk management while also enhancing employee productivity and well-being with improved ergonomics, which has been proven to lower medical costs, reduce absenteeism, and enhance worker satisfaction and productivity. The banking industry plays a crucial role in today’s economy (Bhattarai et al., 2023), requiring banks to provide excellent customer service while complying with regulatory requirements (Naik & Rao, 2022). However, employees in the banking sector often spend long hours sitting at desks, which can impact their health and job performance (Ali et al., 2020). As such, there is an increasing recognition of the importance of ergonomics in enhancing job performance and employee well-being (Sever, 2019).

Traditional office designs have evolved to prioritize human needs and behavior, emphasizing flexibility and adaptability (Chandra et al., 2020). Work-related musculoskeletal disorders (WMSDs) are a common issue, with significant implications for employee health and productivity (Heidarimoghadam et al., 2020). Studies worldwide have highlighted the importance of ergonomics in reducing WMSDs and improving overall performance (Sweeney et al., 2021; Silva & Carneiro, 2023). Thus, humans remain essential in the sociotechnical evolution toward the factory of the future, with extensive literature highlighting the importance of ergonomic principles and human-centered design in optimizing work and workplace design.

To achieve competitive advantage and profitability, organizations need high-performing employees, which involves both behavioral and outcome aspects of performance as defined by Do and Mai (2020). Behavioral aspects include actions taken by employees in their roles, whereas outcome aspects focus on the results of these actions, such as sales figures or successful procedures, ultimately contributing to organizational goals. Bhandari et al. (2024) emphasized that maximizing employee productivity hinges on the relationship between work, the workplace, and tools, with a focus on personal motivation and the work environment's infrastructure. In the demanding financial landscape where accuracy, speed, and customer satisfaction are crucial, the banking sector's success relies heavily on employee efficiency and well-being, with workplace ergonomics serving as a key factor in creating a thriving environment.

For several decades, businesses have been rethinking workplace organizations to meet diverse employee needs, leading to discussions on optimal work environments and flexible, innovative office designs (Rishi et al., 2021; Gratton, 2022). Innovative workplaces that offer flexible hours, inspiring interiors, learning opportunities, and a sense of ownership not only reduce health problems but also enhance productivity, significantly impacting organizational performance (Bolis et al., 2023). Ergonomics in the workplace enhances business value and increases employee engagement, as a healthy work environment fosters innovation and creativity (Agarwal et al., 2025; Afroz & Haque, 2021). Governments mandate safe and healthy job conditions, with ergonomic standards aimed at ensuring employee safety and security (Adamopoulos & Syrou, 2022). By fitting tasks, products, and environments to workers, ergonomics improves quality, productivity, and safety, aligning job demands with workers' capabilities to prevent stress and increase overall organizational success (Kamala et al., 2024). While theories such as the human elements and ergonomics model offer a useful framework for analyzing how organizational and physical elements interact to affect worker performance, inconsistencies exist in the prioritization of these factors

across different studies. Controversies also surround the cost-effectiveness of ergonomic interventions. While some view ergonomics as an unnecessary expense Ranabhat (2015), studies by Asmare and Hailemariam (2025) demonstrate a clear return on investment through reduced discomfort and improved employee well-being.

Employers and employees need to be educated about the benefits of ergonomic practices to improve workplace conditions and employee well-being (Ranabhat, 2015). Despite these challenges, the banking industry across the globe has committed to ergonomic design, recognizing its importance in creating a safe and healthy work environment (Shrestha, 2019; Simkhada et al., 2024). The literature on ergonomics within diverse industries has focused mainly on physical aspects such as workplace design, equipment, and safety, paying less attention to the broader concept of ergonomics and its impact on job performance. Although many studies have been conducted on ergonomics practices, most of these studies have been either quantitative or qualitative. Thus, empirical gap issues focusing on blended methods remain, and several scholars and review papers have highlighted the need to conduct rigorous studies by blending both approaches for robust findings. Furthermore, the ergonomics literature in Nepal remains relatively unexplored, offering a great opportunity to contribute valuable insights. A mixed-methods approach is suitable in this instance because it allows for the exploration of the complexity of the research problem Creswell (2003), potentially yielding more robust findings (Tashakkori & Teddlie, 2011). Likewise, the implementation of ergonomic practices in the banking sector of developing economies is still emerging, although it has recently become a relevant topic. Additionally, prior empirical studies lack the application of mixed methods to explain the relationships between ergonomics practices and employee performance.

In light of these research gaps, this study aims to examine the impact of ergonomic practices on bank employees operating in Kathmandu Valley quantitatively. It explores how agronomic practices affect employee day-to-day performance qualitatively. By drawing on established ergonomics frameworks and addressing the specific context of Kathmandu's banking sector, this study seeks to bridge existing knowledge gaps and contribute to a more comprehensive understanding of the role of ergonomics in enhancing employee performance.

LITERATURE REVIEW

Historical Evolution and Diversification of Ergonomics

Ergonomics, or human factor engineering, designs objects, systems, and environments to increase productivity, comfort, and safety by meeting human needs and capabilities. Originating during the Industrial Revolution with figures such as Bernardino Ramazzini and Frederick Winslow Taylor, it focuses on addressing occupational hazards and improving workplace efficiency (Koirala & Nepal, 2022). The middle 20th century saw the establishment of the International Ergonomics Association (IEA) and the integration of ergonomics in European businesses through work physiology, biomechanics, and anthropometry (Sarri-Chalkidou, 2024). World War II was pivotal for ergonomics, with ergonomic design principles becoming crucial in military equipment design and soldier training. The term "ergonomics" was coined by the British psychologist Hywel Murrell in 1949, formalizing the field (Stack & Ostrom, 2023; Sandom & Harvey, 2004; Wilson, 2000). Similarly, the late 20th century brought new ergonomic challenges with the rise of technology and computers, leading to the field of "office ergonomics" (Wilson, 2000). Ergonomists have addressed issues such as computer equipment design and muscle pain from repetitive actions. The 2000s expanded into interactions with touch-screen devices and virtual environments, influencing industries such as product design and urban planning (Wilson, 2000). The field has diversified into subdisciplines such as cognitive ergonomics, organizational ergonomics, and emotional ergonomics, broadening its scope to include aspects such as human-machine system enjoyment and emotional well-being (Mokdad & Moniem, 2017).

Global Perspectives and Regional Approaches

In the dynamic global business landscape, organizations strive to optimize innovation strategies for both new and established markets. This drive for innovation is fuelled by the need to offer novel or refined products and services, reflecting the increasing dynamism of the global environment (Davenport et al., 2007). Scandinavian practices and the European commitment to employee well-being are pivotal in shaping modern work environments. The UK, for example, emphasizes proper spatial grouping to enhance workflow and employee performance (Xie & Carayon, 2015). Similarly, countries such as Sweden, Denmark, and Norway prioritize ergonomic office design, incorporating elements such as sit-stand desks, ergonomic chairs, and natural lighting (Hanson et al., 2009). In the United States, ergonomics plays a crucial role in workplace safety, with organizations such as OSHA providing guidelines.

American companies often implement office ergonomics programs, including ergonomic assessments, to promote employee health and prevent musculoskeletal disorders. Digital ergonomics is also emphasized,

addressing the impact of technology on worker well-being (Zerguine et al., 2023). In South America, countries focus on workplace safety measures to reduce health risks and emphasize job fit for employee well-being (Soares, 2006). Brazil has implemented ergonomic interventions to identify and correct ergonomic flaws, reducing workers' exposure to musculoskeletal risks (Merino-Salazar et al., 2017). Although limited research has been conducted in Africa, ergonomic principles are gradually being implemented, especially in hazardous industries such as agriculture

Modern ergonomic tools are replacing traditional methods to improve worker safety and reduce musculoskeletal disorders (Mokdad et al., 2019). The global perspective on workplace ergonomics highlights a variety of approaches and priorities across regions. While Scandinavian countries focus on ergonomic office design, the UK emphasizes spatial grouping and workflows. Thus, the United States prioritizes digital ergonomics, and South America addresses musculoskeletal risks, highlighting regional differences in workplace safety and health.

Smollan & Morrison (2019) identified critical elements for implementing office ergonomics, including organizational culture and management support. In contrast, Mokdad et al. (2019) discovered that old methods and financial constraints impede the adoption of ergonomically beneficial equipment. Despite the recognized benefits, ergonomic practices remain limited in industries such as Malaysia's mining sector and small businesses in India, where poorly designed workplaces lead to a high incidence of work-related illnesses (Sen et al., 2020; Satapathy et al., 2023).

In contrast, China's manufacturing industry is increasingly emphasizing "people-oriented" and ergonomic design principles, aligning with global trends toward sustainable and user-friendly industrial design (Koirala & Nepal, 2022). Even though the Asian economy and ergonomics disciplines have grown rapidly since 2000, small businesses in the region frequently lack the resources to adopt ergonomic practices (Hermawati et al., 2014), and the field's understanding and application of ergonomics are still in its infancy despite the growing trend of sustainable and user-friendly industrial design (Thatcher et al., 2018).

Ergonomics remains a relatively new and underdeveloped concept in Nepalese businesses, with many firms unaware of the importance of designing workstations with ergonomic standards. Despite this, terms such as "healthy workplace" and "occupational health and safety" are commonly used in Nepalese organizations, however, research on the importance of ergonomics in Nepal is limited and the adoption of ergonomics practices is not prudent (Nepal & Koirala, 2024). The Nepalese government has taken steps to address this issue by enacting laws such as the Labor Act of 1992 and the Trade Union Act of 1993. However,

a majority of employees express dissatisfaction with their jobs, and most companies admit that they are unable to make necessary modifications (Ranabhat, 2015). Similarly, the government is enforcing labor laws, but most workplaces, especially in construction or transportation, lack ergonomic design. Large companies in the private sector are making some improvements, but small businesses remain largely untouched. This cost-cutting mindset prioritizes short-term gains over employee health and productivity, hindering the wider adoption of ergonomic practices in Nepal (Nepal & Koirala, 2024; Prajapati et al., 2023). Thus, despite efforts, ergonomics has not been widely accepted or integrated into Nepalese enterprises, and many business owners view workplace safety and ergonomic practices as costs rather than essential elements for promoting a healthy and innovative work environment.

When implementing lean practices in an organization, most adopters concentrated solely on hard lean practices tools, and techniques while ignoring human factors and ergonomics (Gedara & Madusanka, 2024). Hard lean methods alone decrease workers' quality of work life (QWL), which results in an inability to achieve the long-term lean performance expected (Biondo et al., 2024). Therefore, it is important to study the effects of human factors and ergonomics (HFE) on performance and sustainability. According to Chen et al., (2021), HFEs include several factors, such as physical factors, which include work postures, static posture, repeated motions, physical porosity, vibrations, extended sitting or standing, lifting heavy weights, etc. Similarly, organizational factors include job rotation, communication systems, coworker support, supervisor support, etc. Accordingly, HFEs and performance are favorably correlated. Several empirical studies (Rahman et al., 2022; Chintada & V, 2022; Afroz et al., 2021) show an association between ergonomic workplace design and improved employee performance.

Research from a wide range of industries, such as government organizations (Makhbul et al., 2022), healthcare facilities (Hellar, 2020), and banking (Dagne et al., 2020), shows that aspects such as appropriate lighting, furniture, and noise levels can greatly improve worker satisfaction and well-being, which in turn boosts productivity. These results highlight how crucial ergonomics is to design workplaces that support worker health and optimal productivity. Similarly, empirical studies highlight the multifaceted effects of ergonomics on office employees. Research by Boadi-Kusi et al. (2021) and Sohrabi and Babamiri (2021) shows how ergonomic training and better workstation design can lessen discomfort, enhance well-being, and even help with conditions such as computer vision syndrome. Additional environmental influences are highlighted by Sun and Han (2021), who demonstrate that temperature impacts worker motivation and cognitive function. Overall,

studies by Makhbul et al. (2022), Ndubuisi (2022), and Akbar (2022) support the relationship between ergonomic workplace design and worker performance, which includes physical comfort, mental health, and ultimately, productivity. These findings highlight the need for organizations to create ergonomic work environments to sustain human resources and remain competitive.

Physical Ergonomics and Employee Performance

Physical ergonomics focuses on designing work environments, equipment, and procedures to increase employees' efficiency, safety, and comfort while reducing the risk of disease or injury. It considers human anatomy, physiology, biomechanics, task demands, and the environment (Rahman et al., 2022). When employees are comfortable and free from pain, they can concentrate better, experience less stress, and have more energy to perform their tasks effectively. This translates to increased productivity, accuracy, and improved overall job performance. For example, proper workstation design, including screen placement and keyboard height, can prevent strain (Boadi-Kusi et al., 2021). Seating arrangements can also impact productivity, as shown by Dagne et al. (2020), who reported that spatial grouping improved workflow and conversation, increasing productivity and safety. Additionally, furniture selection, such as adjustable desks and chairs, can support productivity and well-being (Chen et al., 2021).

Numerous studies have shown (Reiman et al., 2021; Susihono & Adiatmika, 2021; Koirala & Nepal, 2022) that the positive impact of physical ergonomics is evident in various sectors. In manufacturing, ergonomic workstations prevent repetitive strain injuries, reduce absences, and increase production. In office work, adjustable furniture improves comfort and focus, enhancing customer service and sales. In construction, ergonomic tools and techniques prevent injuries, ensuring efficient project completion. Hence, investing in physical ergonomics fosters a mutually beneficial environment for employers and employees, enhancing workplace comfort and health, improving performance, reducing injury-related costs and absenteeism, and ultimately increasing organizational profitability.

Thus, the following hypothesis is proposed:

H1: There is a significant relationship between physical ergonomics and employee performance.

Cognitive Ergonomics and Employee Performance

Cognitive ergonomics, as described by (Zolotova & Giambattista, 2019), studies how interactions with systems affect mental functions such as perception, memory, and decision-making. This dimension of ergonomics emphasizes mental effort, decision-making, and work stress. Cognitive ergonomics optimizes the work environment to enhance mental processes such as perception, attention, memory, and decision-making. Role overload, a significant ergonomic issue, can lead to fatigue, stress, and reduced productivity, negatively affecting employee well-being and performance (Nazir & Amin Beig, 2022). Thus, cognitive ergonomics can significantly increase worker performance by establishing a work environment that reduces the cognitive load and maximizes decision-making processes.

Training and feedback are also important ergonomic factors, as effective training can enhance employee skills and knowledge, leading to improved performance and job satisfaction (Sun & Han, 2021)). According to Christy and Duraisamy (2020), cognitive ergonomics interventions such as training and coaching improved employee efficiency in banks. Maharjan et al. (2023) investigated the effect of cognitive ergonomics on the accuracy of financial decisions made by bank employees. They discovered that better cognitive ergonomics resulted in better decision-making accuracy. The results from earlier empirical research (Rahman et al., 2022; Chintada & V, 2022; Afroz et al., 2021) demonstrate a significant positive relationship between ergonomic practices and employee performance, suggesting that effective cognitive ergonomics interventions boost output, simplify processes, and enhance worker well-being, all of which have a direct impact on worker performance. For example, intuitive electronic health records and decision support tools in the healthcare industry increase diagnostic accuracy and treatment planning. In contrast, clear visual instructions and user-friendly control panel interfaces in the manufacturing industry eliminate errors and increase efficiency. Consequently, implementing cognitive ergonomics concepts is essential to establishing a work environment that maximizes employee performance and improves accuracy, productivity, and overall business success.

Therefore, it can be hypothesized as:

H2: There is a significant relationship between cognitive ergonomics and employee performance.

Organizational ergonomics and Employee performance

Workplace fit is the foundational idea behind the relationship between organizational ergonomics and employee performance. Organizational

ergonomics focuses on enhancing sociotechnical systems such as organizational structures, procedures, and policies to improve employee well-being and performance (Rahman et al., 2022). Factors such as job rotation contribute to physical health but may negatively impact psychological factors; however, they broaden job expertise and social support (Kampkotter et al., 2018). Effective supervisors and coworkers positively influence performance by reducing stress and fostering teamwork (Dagne et al., 2020). Optimizing communication channels and protocols enhances efficiency and regulatory compliance, as demonstrated in the banking sector (Lee et al., 2018). Themes such as communication, resource management, and quality management are pertinent in this context (International Ergonomics Association, 2018). In industries such as manufacturing, office work, and healthcare, ergonomics has been shown to improve worker performance by fostering a supportive work environment that reduces discomfort, fatigue, and cognitive strain.

Kwon et al. (2021) researched the effect of work schedule flexibility on employee performance in a Korean bank and reported that flexible work schedules were linked with greater job satisfaction and work-family balance. Similarly, Aruldoss et al. (2022) investigated the relationship between work hours and performance in a Spanish bank and reported that working more than 40 hours per week was associated with lower job satisfaction (Fuentes, 2016).

Therefore, it can be hypothesized as follows:

H3: There is a significant relationship between organizational ergonomics and employee performance.

Environmental ergonomics and Employee performance

Environmental ergonomics optimizes workplace design for physical, cognitive, and sensory well-being, addressing factors such as lighting, temperature, noise, ventilation, and workstation layout (Jayathilaka & Karunarathne, 2021). Proper lighting, for example, is crucial for avoiding headaches and eye strain, and it can also impact product quality in various industries (Idkhan & Baharuddin, 2019). Maintaining comfortable temperatures and humidity levels is also important, as extreme conditions can lead to discomfort, fatigue, and heat-related illnesses, affecting safety and productivity (Sun & Han, 2021). Enhancing the indoor environment can significantly increase office worker productivity, potentially by up to 10% (Wolkoff et al., 2021). Likewise, empirical studies conducted by Nazir & Amin Beig (2022); Makhbul et al. (2022), Hellar (2020) and Park et al. (2019), in various industries, such as manufacturing plants, office spaces, and healthcare facilities, have consistently indicated a noteworthy positive association between ergonomic workplace designs and enhanced

employee performance indicators, such as increased productivity, accuracy, and reduced error rates. Therefore, by prioritizing environmental ergonomics, companies may design work environments that support employee well-being and, as a result, see significant improvements in performance and business outcomes.

Therefore, it can be hypothesized as follows:

H4: There is a significant relationship between environmental ergonomics and employee performance.

RESEARCH METHOD

This study adopted a sequential explanatory mixed-method design. This combination of quantitative and qualitative methods ensures that the numerical data are enhanced with a detailed contextual understanding, providing a more holistic view of the impact of ergonomics on employee performance. Initially, the quantitative phase involved a survey of 267 banking employees working within Kathmandu Valley through a convenience sampling technique, which provided statistical evidence on the relationship between ergonomics practices and employee performance.

In phase two, individuals' subjective experiences and interpretations were examined through a qualitative technique guided by an interpretivist philosophy. Similarly, a phenomenology approach was deemed suitable for phase two, to explore and understand the actual experiences of employees regarding ergonomics practices within their banks. In a similar vein, Heidegger's interpretative philosophy was used in this study, as this approach recognized the interconnectedness of human experience, emphasizing the significance of social context and dialogical engagement in the interpretive process. Altogether, seven employees who expressed willingness to participate in the study were selected, and semi-structured interviews were conducted purposively with seven employees directly serving customers (i.e. tellers, loan officers, operational charges, and customer service representatives), as they require special attention to ergonomic practices because their roles are physically and mentally demanding. This decision was guided by scholars' recommendations to recruit three to ten participants for a phenomenological study (Smith et al., 2009).

In the first phase, data were collected between April 2024 and May 2024. via personal visits and electronic communication through social media (Viber and WhatsApp) and email with the Kobo toolbox survey

link. Similarly, face-to-face in-depth semi-structured interviews with predetermined interview guides were conducted in July 2024, ensuring consistency across the interviews. In addition, to encourage their participation, some small gifts, such as office diaries and pens, were also given to the responders during personal visits. During data collection, 350 questionnaires were circulated, and 392 responses were received, of which 25 responses in printed form were incomplete and had to be excluded. The remaining 267 responses were found to be useable and represented a good response rate of 76.29%. According to Babbie (2010), a questionnaire survey should be considered very comprehensive if 70% or more of the responses are collected.

The interview protocol, developed based on the reviewed literature, was discussed with the other coauthor and finalized after some amendments to the draft version were made. Every participant was asked to give their verbal consent for the interview, and it was made explicit that their names would be kept anonymous and that no personal information would be used in the study. To ensure thorough data collection, interviewers provided clarification and help through follow-up "what" and "how" questions. The participants were informed about the recording at the beginning of each interview and could turn it off as needed. Similarly, the process of phenomenological analysis described by Benner (1994) was used to analyze the interview data. "Transcription, coding, thematic analysis, and the search for paradigmatic cases and examples" are the four processes in the process (Byrne, 2022). All the interviews were conducted, followed by reading and rereading the manuscript to grasp the participants' insights fully. The interviews were fully transcribed and coded deductively, and the codes were thematically organized. Similarly, the free trial version of MAXQDA was utilized for coding and theme development. After identifying the themes, representative quotes were chosen to highlight these themes from the interview data, both within and across cases.

Table 1

Variables and their Measurement

Constructs	**Number of Observed Items and Adopted from**	**Sample**
Physical Ergonomics (PE)	6 items adopted from (Gumasing et al., 2023; Nawaz et al., 2019)	"My working space is sufficient".
Cognitive	6 items adopted from	"I am given enough

Ergonomics (CE)	(Gumasing et al., 2023; Paais & Pattiruhu, 2020)	time to complete tasks".
Environmental Ergonomics (EE)	6 items adopted from (Makhbul et al., 2022; Deshpande, 2013)	"The noise level in my work area is within normal limits".
Organizational Ergonomics (OE)	7 items adopted from (Duffy, 1999)	"My supervisor respects the worker's opinions".
Employees Performance (EP)	7 items adopted from (Pradhan & Jena, 2017)	"I am capable of taking initiative at work".

Variables and their Measurement

This study adopted existing validated scales from empirical studies. All the items were measured on a five-point Likert scale ranging from "strongly disagree to agree strongly". This study's independent variable comprises four components (i.e.,physical, environmental, cognitive, and organizational ergonomics) and one dependent variable (i.e., employee performance).

To evaluate the content validity of the questionnaire, face validity was carried out with seven study experts who possess a blend of academic (i.e. four university professors) and industry expertise in organizational psychology, ergonomics domains, and human resources professionals. Their insightful feedback has significantly enhanced the questionnaire's external validity, confirming its appropriateness for disseminating the study findings. Similarly, before formal data collection, we conducted a pilot study, following Nunnally's (1978) criteria, with 30 respondents to confirm the reliability and validity of the adopted construct (i.e., the Cronbach's alpha value and VIF scores of all the constructs were within the cutoff criteria).

Similarly, the required demographic information (i.e., gender, age, experience, and position) was also included in the study. The majority (56%) of the respondents were male, whereas the rest were female. In terms of age group, a significant portion (87%) of employees are young employees under 40 years of age, followed by a smaller percentage (13%) of those above 40 years of age. Similarly, in terms of corporate positions, the majority (58%) serve as assistants, followed by supervisors (20%), officers (18%), and a scant percentage in managerialroles (4%). Similarly, the majority (70%) of the respondents had 1--6 years of working

experience, followed by nearly one-third (30%) with more than 6 years of working experience.

RESULTS

Analysis Phase I: Quantitative Approach

Descriptive and inferential analyses were conducted via Smart-PLS 4.0 and SPSS Version 23. The study begins by assessing the normality of the distribution of scale items. The results obtained from the descriptive statistics show that the mean value is in the range of 2.933 -- 4.131, whereas the standard deviation spans from 0.730 --1.077, indicating low variability in the dataset. As recommended by Curran et al. (1996), the threshold values for skewness +/- 2 and kurtosis value +/- 7 have been satisfied, demonstrating that a normal distribution has been satisfied and indicating that the data are suitable for further statistical analysis. On the other hand, we also utilized Knock's (2015) modern approach for computing Common method bias (CMB) by employing the variance inflation factor (VIF). We conducted a full collinearity assessment, confirming that all the VIF values remained below 3.3. Thus, we can conclude that CMB is not an issue in this study.

The model classified the relationships between the latent and observed items as reflective. This is because changes made to the latent variables impact how the observable variables are measured. Similarly, following the procedure recommended by Hair et al. (2019), the proposed research model was evaluated via a two-stage approach, i.e., a measurement and structural model.

Measurement Model Results

Reliability and validity were evaluated via the measurement model assessment approach recommended by Hair et al. (2019). Reliability was assessed through "Indicator reliability," "Cronbach's alpha," and "Composite reliability (CR)," with all values exceeding the threshold of 0.70, as suggested by (Cohen, 2013; Hair et al., 2019), demonstrating good internal consistency among the measures. In contrast, three items (i.e., PE_6, EE_6, and EP_3) were dropped because of low factor loading issues. For convergent validity, three criteria are satisfied, i.e., AVE>0.5, CR>0.7, and CR> AVE. The detailed results are in Table 2.

Additionally, the Fornell–Larcker technique, Heterotrait–Monotrait (HTMT), and cross-loading were used to evaluate discriminant validity. According to the Fornell–Larcker criterion, a classical method, the square root of the AVE should be greater than the correlation values among all target constructs (Fornell & Larccker, 1981).

Table 2
Reliability and validity

Constructs	Observed Items & Coding	Standardized Factor Loading (SFL)	Average Variance Extracted (AVE)	Composite Reliability (CR)	Cronbach's Alpha
Physical Ergonomics	PE_1	0.747	0.618	0.889	0.845
	PE_2	0.83			
	PE_3	0.875			
	PE_4	0.723			
	PE_5	0.742			
Environmental Ergonomics	EE_1	0.77	0.563	0.865	0.815
	EE_2	0.769			
	EE_3	0.769			
	EE_4	0.733			
	EE_5	0.709			
Cognitive Ergonomics	CE_1	0.748	0.613	0.905	0.873
	CE_2	0.78			
	CE_3	0.791			
	CE_4	0.833			
	CE_5	0.835			
	CE_6	0.704			
Organizational Ergonomics	OE_1	0.738	0.557	0.898	0.867
	OE_2	0.753			
	OE_3	0.716			
	OE_4	0.744			
	OE_5	0.761			
	OE_6	0.778			
	OE_7	0.732			
Employees Performance	EP_1	0.798	0.655	0.919	0.894
	EP_2	0.755			
	EP_4	0.869			
	EP_5	0.854			
	EP_6	0.779			

EP_7	0.794

Table 3
Discriminant validity - Fornell and Larcker test

	CE	EE	EP	OE	PE
CE	**0.783**				
EE	0.453	**0.75**			
EP	0.611	0.429	**0.809**		
OE	0.635	0.428	0.726	**0.746**	
PE	0.397	0.383	0.47	0.541	**0.786**

Table 4
Discriminant validity - HTMT test

	CE	EE	EP	OE	PE
CE					
EE	0.516				
EP	0.678	0.468			
OE	0.727	0.485	0.814		
PE	0.456	0.432	0.526	0.618	

Structural Model Analysis

Once the measurement model is deemed satisfactory, the structural model assessment results are evaluated. As noted by Hair et al. (2019), the structural model confirms the causal relationships between exogenous and endogenous variables. Similarly, we employed a bootstrapping approach with a resampling rate of 10,000 to evaluate our study model. In addition, the primary objective of bootstrapping was to obtain the path coefficient, which included the bootstrapping confidence intervals, beta values, standard errors, t values, and p- p-values.

The R-square was used to assess the model's explanatory power. The R-square value of the EP was 0.576, which signifies a moderate predictive power level of the model of Hair et al. (2020), which is explained by four independent variables. Additionally, the inner VIF values were used to determine multicollinearity. All the VIF values were less than 5.0, indicating that no multicollinearity issues were present in our study (Hair et al., 2019). Similarly, the study model fit was revealed by the "Standardized root means square residual (SRMR)" value of 0.081, which

was within the criterion of 0.10 (Henseler, 2014).

Figure 1
Path analysis

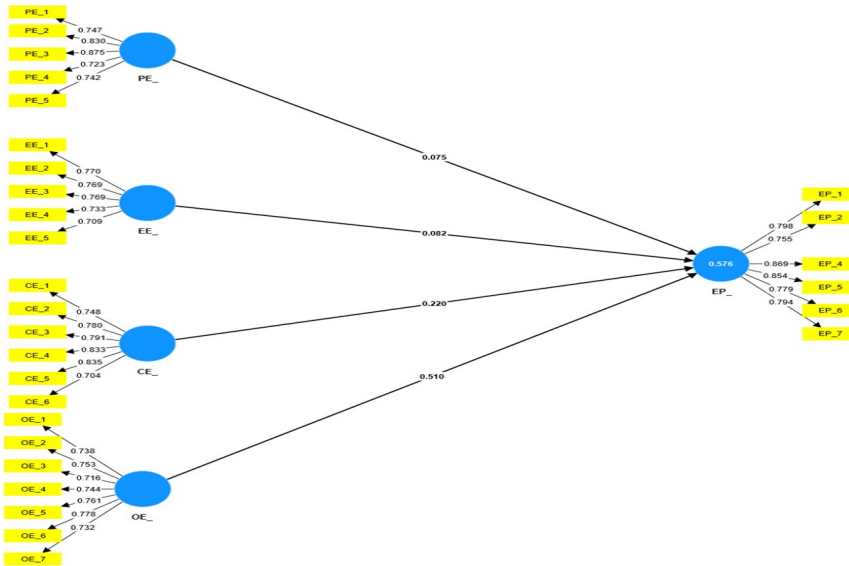


Table 6
Empirical Results of the Structural Path

Structural Path	Beta Coefficient	SE	t-values	P-values	Empirical Decision
H1: PE -> EP	0.075	0.052	1.443	0.149	Not Supported
H2: EE-> EP	0.082	0.046	1.78	0.075	Not Supported
H3: CE-> EP	0.22	0.054	4.068	0.000	Supported
H4: OE-> EP	0.51	0.058	8.867	0.000	Supported

Furthermore, the study examined the causal relationship by analyzing the direct effects of economic practices on employee performance. The

findings of the bootstrapping approach are detailed in Table 5. An analysis of the direct relationships clearly reveals that the relationship between physical ergonomics and employee performance was statistically insignificant (β = 0.075, t = 1.443, p-value = 0.149). Hence, H1 was rejected. By H2's findings, environmental ergonomics and employee performance exhibit a statistically insignificant relationship (β = 0.082, t = 1.78, p-value = 0.075), which means that H2 is rejected. Similarly, cognitive ergonomics significantly improves employees' performance (β = 0.22, t = 4.068, p-value = 0.000), confirming H3. Furthermore, organizational ergonomics significantly affects employee performance (β = 0.051, t = 8.867, p-value = 0.000). Thus, hypothesis 4 is accepted.

The quantitative findings offer strong evidence that organizational and cognitive ergonomics greatly affect workers' productivity in the banking industry. These findings imply that optimizing technology, procedures, and organizational support systems can increase task efficiency, reduce fatigue, and improve overall performance. However, the findings suggest that environmental and physical ergonomics may not be as impactful in this context. The less physically demanding nature of banking tasks compared with other professions could explain this. Additionally, individual coping mechanisms and inconsistencies in the application of ergonomic standards across branches might influence the results.

Table 7
Sociodemographic Profile

Case	Gender	Position	Working Experience
P1	Female	Customer Service Department (CSD)	2 Years
P2	Female	Customer Service Department (CSD)	3 Years
P3	Male	Teller	2 Years
P4	Female	Operational Incharge	7 Years
P5	Female	Teller	2 Years
P6	Male	Loan Officer	9 Years
P7	Male	Operational Incharge	7 Years

Analysis Phase II: Qualitative Approach

The demographics of the seven respondents holding the positions of customer service department, teller, operational in charge, and loan officer are provided in Table 7. The researcher gave each participant a pseudonym, ranging from P1 to P7, to maintain their identities. Similarly, four female and three male participants were interviewed at their respective banks in a closed environment.

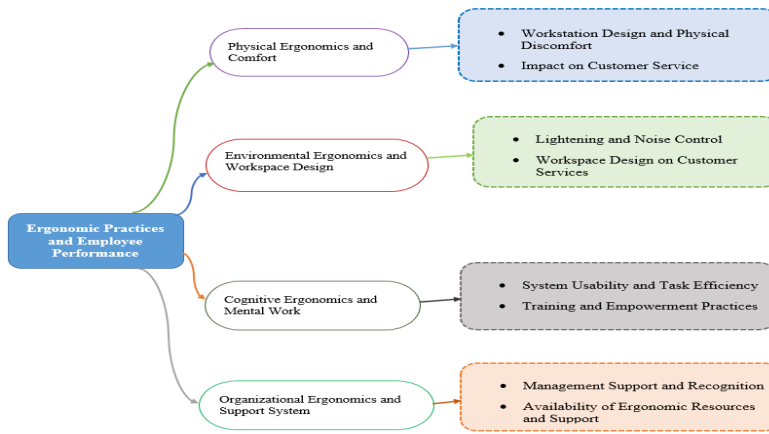
Four major themes emerged from the thematic analysis of these interviews: physical ergonomics and comfort, environmental ergonomics and workspace design, cognitive ergonomics and mental workload, and organizational ergonomics and support systems.

Theme 1: Physical ergonomics and comfort

This theme highlights how physical workspace design and equipment influence interactions with customers. The majority of the responders stressed having physical discomfort in their roles. Desk heights and chair adjustments were frequently cited as crucial elements that had a major impact on their well-being and productivity.

Figure 2

Thematic Diagram



Theme 2: Environmental ergonomics and workspace design

Workplace environments, such as design and layout, are noted to impact efficiency and interaction with customers. The respondents demonstrated mixed responses. Most respondents reported having

improper workplace stations, whereas two respondents expressed how a well-planned environment decreased stress and improved customer service.

#P3, P5, with a thoughtful nod, shared; "*Our teller counter and customer service area has truly harsh light. By the end of the day (….) creates a headache and makes it difficult to focus".*

#P1, P6, P7 echoed *equivocally: "People talking on their phones and other background noise never stops (….) it is irritating and distracting (….) makes it hard to hear customers clearly and contributes to the overall stress level".*

These two quotes from the respondents suggested that inadequate light and excessive noise are concerns of the employees in the banks, which can lead to physical discomfort, and impact communication, focus, and employee well-being. In contrast, # P2, P4 is a loan officer with a genuine smile: *"In recent years, our bank brought good chairs, adjustable workstations, and designated quiet rooms (….) which reduced fatigue, improved comfort, (….) and a more positive work environment".* This highlights that an adjustable and proper working environment in banks can create a more comfortable and productive work environment for customer-facing employees.

Theme 3: Cognitive ergonomics and mental workload

This theme highlights how well system usability, empowerment practices, and information flow play a significant role in improving employee performance, reducing mental fatigue, and enhancing job satisfaction. The participants particularly appreciated the streamlined process and interactive software.

P1, P3, and P5 share a positive nod*: "Having access to user-friendly software and clear procedures makes an enormous difference (….) I can complete tasks much faster and with few errors, (….) allowed me to focus more on* customers' needs". These excerpts emphasize how the positive impacts of user-friendly technology and streamlined processes have enhanced the efficiency and effectiveness of employees in banks.

Amid the conversation, all the participants (#P1 to P7) expressed that *training and development programs organized by banks on technical skills, and soft skills (….) have made our job much easier and enjoyable (….) The decision support system that our bank is using is helping to make quicker and more accurate decisions".* This highlights the importance of empowering employees with different aptitudes to handle diverse circumstances, which allows them to focus on critical aspects of their job without being bogged down by data retrieval, and processing, and making daily tasks less mentally taxing and more engaging.

Theme 4: Organizational Ergonomics and Support System

Support from management, availability of ergonomic resources, and recognition were frequently stressed phrases by the participants, which played a critical role in maintaining high performance and morale. When an organization meets and supports the ergonomic demands of its employees, those workers may feel more appreciated and driven.

#P1, P3, P6: *It makes a great difference to be appreciated by my superiors through recognition programs, or even just a simple "thank you" (.....) motivates me to go the extra mile for my customers."*

In addition, respondent #P7 stated, *"My confidence and performance have greatly increased with the support of management (....) and clear guidelines. Our manager is proactive in ensuring that we have the right tools (.....) shows that banks care about our well-being (....) which makes a big difference in how I feel about my job ".*

In summary, the qualitative findings highlight the critical role of ergonomics in the banking sector, revealing that physical and environmental factors significantly impact productivity and well-being. In contrast, cognitive and organizational factors enhance efficiency and morale. Hence, these findings emphasize the importance of tailored ergonomic interventions to optimize workplace conditions and employee performance in banking environments.

DISCUSSION AND CONCLUSIONS

The study sheds light on the fundamental issues related to how ergonomics practices influence employee performance in the banking sector. The sequential explanatory mixed method was employed, blending quantitative (SEM) and qualitative (thematic analysis) methods. The qualitative data provided valuable insights into the "how" and "why" behind these relationships. Drawing on employee narratives, this research explores the lived experiences of ergonomics practices and enriches the statistical results with a deeper understanding of employee perspectives. The combined analysis offered a more comprehensive picture of the impact of ergonomics on the performance of banking employees from developing countries such as Nepal.

Similarly, the quantitative analysis highlighted a significant association between cognitive and organizational ergonomics, whereas physical and environmental ergonomics were found to have an insignificant relationship with employee performance. Our findings align with the findings of previous studies (Hu, 2017; Navimipour, 2015; Schaule, 2018), which revealed that clear procedures, a user-friendly interface, and training programs enhance employees' performance, decrease their cognitive load, and increase their job satisfaction. Similarly,

these findings align with the qualitative results, as participants noted, of the significant impact of efficient processes and intuitive software. Consistent with the literature, the results of organizational ergonomics are in line with those of other studies (Welsh, 2015; Barmore & H. R., 2019; Nyamekye & F., 2012), which revealed that management support, recognition, and providing prudent resources for employees can positively enhance employee morale and performance. Parallel to this notion, the participants in the interviews echoed these sentiments, highlighting the importance of recognition and resource availability. The significant relationships observed for cognitive and organizational ergonomics may be attributed to the direct impact these factors have on mental workload and organizational support, which are crucial for job performance in a cognitively heavy and customer-oriented industry such as banking. Thus, streamlined processes and supportive management create an environment where employees can perform efficiently and feel valued.

In contrast to Singh and J (2000) and Ramlall (2008), who emphasized the importance of physical ergonomics in preventing discomfort and enhancing performance, our findings did not reveal a significant relationship. This disparity could be attributed to the unique demands of banking tasks, which may not be as physically taxing as other professions, thereby lessening the influence of physical ergonomics. Furthermore, the findings of this study are in line with those of numerous studies (Attaianese & E., 2017; Arif et al., 2016; Altomonte et al., 2020), which have highlighted those environmental elements, including lighting and noise, have significant impacts on both performance and well-being. Similarly, the qualitative findings, which emphasize the discomfort and distraction caused by poorly designed workplaces, however, are consistent with those of previous studies. Therefore, the lack of significance of environmental and physical ergonomics may result from the less physically demanding nature of banking work, individual variations in coping strategies, and the inconsistent use of ergonomic standards throughout branches.

The study's mixed-method inferences offer a comprehensive picture of how ergonomics procedures affect bank workers' productivity. Both quantitative and qualitative evidence corroborated the strong positive effects of cognitive and organizational ergonomics, which emerged as crucial determinants. Although not statistically significant, the qualitative findings identified environmental and physical ergonomics as areas that require attention to enhance employee comfort and focus. This seemingly contradictory picture is enriched by qualitative data. These integrated findings suggest that a holistic approach to ergonomics that takes into account physical, cognitive, organizational, and environmental aspects can

improve the work environment and increase employee satisfaction and performance.

The findings of our study are consistent with the effective implementation of ergonomic practices by many organizations. For example, Google and Apple demonstrated how ergonomic practices such as well-designed workspaces and strong managerial support improve employee performance and satisfaction. Additionally, these results support the job demand-resource (JD-R) paradigm by demonstrating how organizational and cognitive ergonomics improve worker engagement and performance by supplying necessary job resources, adding to the body of knowledge in the fields of ergonomics and performance. The quantitative analysis provided a broad overview of the significant association between ergonomic practices and performance, whereas the qualitative analysis enriched this understanding by postulating specific aspects of each ergonomic domain that matter most to employees. While environmental and physical ergonomics, for example, were not statistically significant, qualitative data indicated that certain environmental stressors and discomfort impact performance, indicating that tailored interventions may still be helpful. Furthermore, the significance of adjustable workstations (physical ergonomics) and designated quiet places (environmental ergonomics) was highlighted by the qualitative data, which were not immediately reflected in the quantitative analysis.

Drawing from the study's results, the researcher devised a new thematic model i.e., the Cognitive Organizational Ergonomics Synergy (COES) model, which incorporates the interaction of organizational and cognitive ergonomics as a key factor influencing employee performance, efficiency, and job satisfaction in highly cognitive and customer-focused industries. It is especially significant in modern workplaces, such as STEM fields, banking, and technology-driven workplaces where performance is greatly impacted by mental workload management and structured organizational support. By promoting a move toward organizational adaptability and cognitive load management as key ergonomic strategies in knowledge-intensive fields, the COES model questions existing ergonomics theories and provides a fresh perspective for future research to investigate ergonomic optimization beyond traditional workplace design.

IMPLICATIONS

This study offers a novel perspective on ergonomics within the banking sector, which is particularly relevant to developing countries such as Nepal. The findings highlighted the significant role of cognitive and organizational ergonomics in enhancing employee performance,

challenging traditional assumptions that often emphasize physical and environmental ergonomics. This aligns with the job demand-resource (JD-R) model, suggesting that ergonomic practices function as job resources, reducing mental workload and fostering employee engagement. Furthermore, this study provides valuable insights into how ergonomic practices can be tailored to meet the specific needs of banking employees in Nepal, contributing to the limited body of knowledge from a developing country perspective. Likewise, its rigorous methodology and diverse empirical sources provide a comprehensive understanding of ergonomics practices, significantly contributing to the theoretical framework of the field. Thus, the study concludes that cognitive and organizational ergonomics significantly influence employee performance in the banking sector, highlighting the importance of mental workload management and organizational support and addressing the research gap by emphasizing the need for tailored ergonomic practices in cognitively heavy industries and contributing to the theoretical understanding of ergonomics by distinguishing the specific roles of different ergonomic dimensions in employee performance.

On the other hand, the findings translate to practical benefits for various stakeholders. Bank management can leverage this knowledge to design work environments prioritizing streamlined processes, user-friendly technology, and supportive work cultures. This can lead to improved employee performance, satisfaction, and well-being.

Similarly, the findings of the study have interdisciplinary relevance. The findings offer significant insights that can be converted into actionable strategies for STEM workplaces (such as laboratories, educational institutions, and technology-driven workplaces) and learning environments. The significant role of organizational and cognitive ergonomics in banking demonstrates that similar ergonomic principles may be effectively applied in the STEM fields to streamline the workforce, optimize decision-making, and diminish cognitive workload and environmental stressors. The qualitative insights of the physical and environmental ergonomics emphasize their effects on employees' well-being. They can be implemented in STEM workplaces, where ergonomics interventions such as noise control, adjustable workstations, and optimized lighting can substantially influence their focus and productivity.

Policymakers can utilize this study to advocate for ergonomic standards within the Nepalese banking sector and STEM fields, focusing on cognitive and organizational aspects. While physical and environmental ergonomics may not have had statistically significant effects, the qualitative data suggests potential benefits from adjustable workstations and designated quiet areas. Considering individual variations in coping mechanisms, tailored interventions that address both

these aspects alongside cognitive and organizational factors can optimize the work environment for banking employees. Additionally, organizations can use these results to enhance occupational health and safety practices, whereas financial industry associations can develop regulations that promote standardized ergonomic practices across sectors.

This study has several limitations that provide opportunities for future research. The study focused solely on employees working in commercial banks (i.e., Class A). Future studies could expand the scope by encompassing a wider range of banks (i.e., Class B and C). Similarly, further study could expand the model by incorporating mediating and moderating variables such as job satisfaction, stress, employee age, and personality, which would offer valuable insights into the mechanism and boundary conditions that shape the impact of ergonomics on job performance and employee outcomes. In addition, this study provides explicit insights into the banking sector. Future research could explore ergonomics in other specific service sectors, such as call centers (i.e., intense customer interactions) and insurance companies (i.e., complex tasks), as it could broaden the understanding of context-specific ergonomic challenges. Likewise, future research in the service sector should explore how emerging technologies such as automation, AI, and VR impact ergonomics, job performance, and work engagement, providing insights to optimize work environments and enhance employee well-being.

Contributions load

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