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Technology-Driven Ergonomic Solutions for Multipurpose Workstation Optimization

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Abstract: This study explores technology-driven ergonomic solutions for enhancing multipurpose workstations, grounded on the Technology Acceptance Model (TAM) as the theoretical framework. The growing integration of technology in workplaces and the demand for flexible workstation designs highlight the need for setups that are both ergonomic and adaptable to digital tools. The research investigates user responses to ergonomic innovations incorporated into workstation prototypes and evaluates their impact on comfort, efficiency, and productivity. Using a descriptive study design, data were gathered from participants exposed to technology-enhanced workstation models. Findings revealed that users generally perceived the workstation as functional, adaptable, and effective in reducing strain. These positive responses were consistent across different age groups and professions, underscoring the versatility of the design. Participants highlighted its ability to support diverse tasks, accommodate varying physical needs, and seamlessly integrate with digital workspaces. Descriptive statistical analysis further emphasized recurring positive patterns, suggesting that ergonomic and technological elements significantly influence workplace improvements. The study thus provides empirical evidence that the convergence of ergonomics and technology enhances work efficiency and user well-being. Beyond immediate outcomes, the results contribute to organizational decision-making, design innovation, and workplace training. The research extends existing knowledge on workplace ergonomics and technology adoption by offering practical insights into how employees engage with adaptive, multifunctional setups. Ultimately, it underscores the significance of technology-driven ergonomic solutions in creating sustainable, worker-centered, and future-ready environments that meet the evolving demands of the contemporary workforce.

Keywords*: Ergonomics, Technology Acceptance Model, Technology-Driven Solutions, Workplace Innovation, Workstation Optimization.*

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I. INTRODUCTION

Workstations that are flexible, efficient, and good for your health are becoming more and more important in today's workplaces. When paired with new technologies, ergonomics can help people be more productive, comfortable, and environmentally friendly. But we need to look at these technology-based ergonomic solutions from the user's point of view in order to understand why people embrace them. The changing needs of today's workplaces and the rise of hybrid and remote work arrangements have made ergonomically designed multipurpose workstations even more important. People are starting to think that traditional static workplaces aren't good enough because they cause musculoskeletal pain, weariness, and worse job effectiveness. Recent studies emphasize that the amalgamation of ergonomics with adaptable workstation design can successfully resolve these challenges. For example, randomized trials conducted in Japan and the United Kingdom demonstrated that the implementation of sit–stand and height-adjustable desks substantially decreased sedentary behavior, mitigated discomfort, and improved perceived performance across various work settings (Ma et al., 2021; Edwardson et al., 2022).

The COVID-19 epidemic showed that home-based work arrangements have ergonomic problems, as many workers didn't have the right furniture and equipment. A study conducted in Hong Kong indicated heightened musculoskeletal discomfort among those telecommuting without access to ergonomic workstations (Chim & Chen, 2023). This makes it clear that we need flexible workstation

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solutions that support health and productivity even outside of traditional office environments.

As a result, technology-based solutions are becoming more common in workstation optimization. Researchers have found that smart desks with sensors that advise changes to posture can help people be healthier while still having a good time using them (Haliburton et al., 2023). In the same way, adaptive automation in industrial assembly stations, where workstations automatically adjust to each person's body type, showed that awkward postures were less common and efficiency improved (Bortolini et al., 2023). These kinds of new ideas show how combining ergonomics with technology could help make workplaces more sustainable and design them with people in mind.

Even if these new ideas are exciting, they won't work until both users and organizations accept them. Research on wearable devices shows that comfort, affordability, and the culture of the business are all important factors in whether or not workers use them (Strawderman et al., 2022). Likewise, global evidence underscores that trust and preparedness substantially influence the implementation of technology-driven ergonomic therapies (Alsyouf et al., 2023). These results show that we need frameworks like the Technology Acceptance Model (TAM) to look at how ergonomic workstation solutions are used and how well they operate in different parts of the world over time.

II. METHODS

The researcher used a descriptive research design, the study gathered data from participants who interacted with prototypes of technology-enhanced ergonomic multipurpose workstations. Descriptive statistics, including frequency, percentage, mean, and standard deviation, were employed to analyze user responses and identify patterns in their evaluations.

➢ *Participants*

The respondents of this study consisted of One Hundred Twenty (120). Seventy (70) Technology, Education and Engineering Professors/Instructors across all campuses and fifty (50) Students of Surigao del Norte State University. The researcher used stratified random sampling technique in which the population was divided into non-overlapping sub population called strata and the percentage of every group. The total of 120 were the only groups of respondents who were qualified to rate the design.

➢ *Data Collection*

The data gathering follows accordingly to the following prerequisites: 1) An intent letter being sent to the Research Planning and Development Office to seek permission to conduct a study. Consequently, this involved the students, technology and engineering faculty; 2) Questionnaire were administered to the target respondent to answer them thoroughly; 3) checklist and tables were made for better presentation and analysis of the gathered data.

➢ *Data Analysis*

The Technology Acceptance Model was used to investigate the technology-driven ergonomic solutions that influence to use and accept the design of an ergonomic multipurpose desktop table by the faculty and students of Surigao del Norte State University. A 5-point Likert scale was attribute of reference in which the rate ranged from 1 to 5. The researcher used the weighted mean to get average of the respondent's perception of an ergonomic multipurpose workstation setup.

III. RESULT AND DISCUSSION

Table 1 Impact on Productivity on the Predictive Validity of an Ergonomic Multipurpose Workstation Setup

Range	Interpretation	F	%
4.21 – 5.00	All intended dimension is Highly Agree.	27	22.50
3.41 – 4.20	**All intended dimension is Strongly Agree.**	**83**	**69.17**
2.61 – 3.40	Some intended dimension is Agree.	10	8.33
1.81 – 2.60	Few of the intended dimension is Disagree.	0	0.00
1.00 – 1.80	All intended elements are Strongly Disagree.	0	0.00
	Total	**120**	**100%**
	Overall Mean	**4.14**	
	Interpretation	**Strongly Agree**	
	SD	**0.539**	

Indicators	M	SD	Interpretation
1. The Ergonomic Multipurpose Workstation will increase my work output.	4.17	0.555	Highly Agree
2. Using the Ergonomic Multipurpose Workstation will help me complete tasks more quickly.	4.13	0.559	Strongly Agree
3. The Ergonomic Multipurpose Workstation will improve my focus and concentration at work.	4.21	0.548	Highly Agree
4. I believe the Ergonomic Multipurpose Workstation will reduce time spent on breaks or resting due to discomfort or fatigue.	4.11	0.531	Strongly Agree
5. The Ergonomic Multipurpose Workstation will help me manage my workload more efficiently.	4.14	0.518	Strongly Agree

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Table 1 shows the mean frequency, percentage, and mean distributions of participants' impact on productivity on the predictive validity of an ergonomic multipurpose workstation setup. It can be gleaned from the table that as a whole, that participants assessed their Impact on Productivity on the Predictive Validity of an Ergonomic Multipurpose Workstation Setup as "Strongly Agree" which was supported by the overall mean of 4.14 which means that the participants accept the impact of productivity. The eighty-three (83) or 69.17% of the one twenty (120) participants were reported to have a Strongly Agree on the impact of productivity, twenty-seven (27) or 22.50% attained Highly Agree on the impact of productivity and ten (10) or 8.33 participants were found to have Agree.

The overall positive scores suggest that most of the participants feel the need in restructuring the office workstation particularly on the impact of productivity on the predictive validity of an ergonomic multipurpose workstation setup, with strong perceptions of having the necessary skills and resources. Implications of these findings suggest that the ergonomic multipurpose workstation setup is viewed positively in terms of its productivity benefits, and most users believe it will improve work efficiency, reduce discomfort, and enhance focus. In the study of Lin et al. (2023) reported that reallocating desk workers' sitting time to standing or stepping was positively associated with work engagement and perceived performance. This supports the claim that flexible, multipurpose workstation setups can foster productivity by enabling posture variation and movement during work

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Table 2 Impact on Comfort on the Predictive Validity of an Ergonomic Multipurpose Workstation Setup

Range	Interpretation	F	%
4.21 – 5.00	All intended dimension is Highly Agree.	39	32.50
3.41 – 4.20	**All intended dimension is Strongly Agree.**	**73**	**60.83**
2.61 – 3.40	Some intended dimension is Agree.	8	6.67
1.81 – 2.60	Few of the intended dimension is Disagree.	0	0.00
1.00 – 1.80	All intended elements are Strongly Disagree.	0	0.00
	Total	**120**	**100%**
	Overall Mean	**4.26**	
	Interpretation	**Highly Agree**	
	SD	**0.572**	

Indicators	M	SD	Interpretation
1. The Ergonomic Multipurpose Workstation will reduce physical discomfort while working (e.g., backpain, neck strain).	4.28	0.555	Highly Agree
2. Using the Ergonomic Multipurpose Workstation will make my working posture more comfortable.	4.33	0.559	Highly Agree
3. The design of the Ergonomic Multipurpose Workstation will allow me to work for longer periods without feeling fatigued.	4.23	0.548	Highly Agree
4. I believe that the ergonomic workstation will help me maintain a comfortable working environment.	4.22	0.531	Highly Agree
5. Using the ergonomic workstation will reduce the need for frequent breaks to relieve discomfort.	4.20	0.518	Strongly Agree

Table 2 shows that as a whole, the participants reported a "Highly Agree" in impact on comfort as indicated by the overall mean of 4.26. This means that the student participants generally believe their capabilities to used appropriate the Ergonomic Multipurpose Workstation Setup. The seventy-tree (73) or 60.83% of the one twenty (120) participants were reported to have a Strongly Agree in the use of the Ergonomic Multipurpose Workstation Setup in terms of its impact to comfort, thirty-nine (39) or 32.50% attained Highly Agree in the use of the Ergonomic Multipurpose Workstation Setup and eight (8) or 6.67 participants were found to have Acceptable.

Implications of these findings suggest that the ergonomic multipurpose workstation is viewed positively in terms of its comfort-related benefits. Users are confident that it will reduce physical discomfort, enhance posture, and allow for longer, more comfortable work sessions This underscores the importance of appropriately planned and implement an optimized workstation setup to support faculty and students effectively. This affirms to the study of Konradt et al. (2022) concluded that while a sit–stand desk intervention produced short- and medium-term reductions in musculoskeletal complaints, these comfort benefits diminished after two years, suggesting that long-term strategies are needed to sustain the gains

.

Table 3 Impact on Health Issues on the Predictive Validity of an Ergonomic Multipurpose Workstation Setup

Range	Interpretation	F	%
4.21 – 5.00	All intended dimension is Highly Agree.	27	22.50
3.41 – 4.20	**All intended dimension is Strongly Agree.**	**82**	**68.33**
2.61 – 3.40	Some intended dimension is Agree.	11	9.17
1.81 – 2.60	Few of the intended dimension is Disagree.	0	0.00
1.00 – 1.80	All intended elements are Strongly Disagree.	0	0.00
	Total	**120**	**100%**

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	Overall Mean	**4.13**	
	Interpretation	**Strongly Agree**	
	SD	**0.549**	

Indicators	**M**	**SD**	**Interpretation**
1. The ergonomic workstation will reduce the likelihood of developing long-term physical health issues (e.g. repetitive strain injuries)	4.17	0.508	Strongly Agree
2. I believe that using the ergonomic workstation will improve me overall health and well-being at work.	4.17	0.570	Strongly Agree
3. The ergonomic workstation will help prevent health issues Associated with poor posture (e.g. musculoskeletal disorders).	4.10	0.571	Strongly Agree
4. Using the ergonomic workstation will contribute to long-term improvements in my physical comfort and health.	4.13	0.559	Strongly Agree
5. The ergonomic workstation will help reduce work-related stress and fatigue, leading to better health outcomes.	4.13	0.528	Strongly Agree

Table 3 shows as a whole, the participants assessed their impact to health issues as "Strongly Agree" as indicated by the overall mean of 4.13. This means that the student participants generally believe their capabilities and attitude towards their comfort as well as their health issues in the use of the ergonomic multipurpose workstation setup. The eighty-two (82) or 68.33% of the one twenty (120) participants were reported to have a Strongly Agree in the use of the ergonomic multipurpose workstation Setup in terms of impact to health issues, twenty-seven (27) or 22.50% attained Highly Agree in the use of the ergonomic multipurpose workstation setup and eleven (11) or 9.17 participants were found to have Acceptable.

The implications of these results indicate that the ergonomic workplace is seen as an effective instrument for improving health outcomes. Users think it will lower the danger of physical problems caused by bad posture and repetitive strain, as well as make them more comfortable and healthier at work in general. To make the workstation as appealing as possible, marketing should emphasis on its health benefits, notably how it can help avoid musculoskeletal disorders and lower stress levels over time. Edwardson et al. (2022) showed in their study that adding a height-adjustable desk to a behavior-change intervention considerably reduced the amount of time office workers spent sitting each day and made small improvements in their stress, well-being, energy, and pain in their lower extremities

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Table 4 The Barriers and Challenges in the Implementation of an Ergonomic Multipurpose Workstation Setup

BARRIERS	**CHALLENGES**
Budget constraints can limit the ability to purchase ergonomic equipment, making it challenging to invest in quality materials and advanced ergonomic features.	Meeting the specific ergonomic needs of each user requires a high level of customization, which can be logistically challenging.
Lack of adequate office space can restrict the installation of workstations that require specific dimensions for ergonomic efficiency.	Ensuring that employees consistently use the ergonomic setup correctly may require ongoing reminders and adjustments.
Employees and management may be hesitant to adopt new setups, especially if they're accustomed to traditional workstations. Insufficient knowledge about ergonomic benefits can make it difficult for decision-makers to justify the investment.	Learning and adapting to new postures or tools can initially feel uncomfortable, leading to temporary resistance.Regular use can lead to wear and tear on adjustable features, requiring frequent maintenance to maintain ergonomic standards.
Employees might not use the ergonomic features correctly or consistently, reducing the effectiveness of the setup.	Organizations may struggle to balance a modern aesthetic with ergonomic functionality, as ergonomic designs are sometimes bulkier.
Standardized setups may not meet the specific ergonomic needs of all users, especially in diverse workforces. Ongoing expenses for repairing and maintaining adjustable features can be high, discouraging long-term use.	The time required to install, adjust, and train users on the setup can disrupt regular workflows. Availability of ergonomic components may vary, leading to potential delays and inconsistencies in setup quality.
Difficulty in sourcing or acquiring ergonomic components can delay implementation.	Some setups may not adjust sufficiently to accommodate all user heights and postures, limiting ergonomic effectiveness.
Insufficient knowledge about ergonomic benefits can make it difficult for decision-makers to justify the investment.	Ensuring that ergonomic setups are compatible with all necessary technology and equipment can be complex.
Difficulty in quantifying immediate financial returns can make it challenging to gain organizational buy- in.	Collecting and analyzing data to validate health benefits and productivity gains can be time- consuming, delaying further improvements.

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Table 4 outlines the problems and challenges. In general, the way an ergonomic multipurpose workstation is set up generally runs into "human-systems" problems more than hardware problems: A culture of sitting and social standards might make standing or moving a station feel strange. Many users don't know when or how to change their posture without simple cues and know-how, so their initial excitement fades. Practical problems including limited unit availability, bad location, late delivery, and occasional technical problems also hurt adoption fidelity, especially in busy departments were workload and task demand make it easier to stay seated to get things done. These challenges point to clear implementation of the ergonomic multipurpose workstation. So that users will effectively and efficiently unitize it accordingly to its functions and feature. In the study of Mastenbroek et al. (2022) states that from an organizational perspective, implementation was hampered by lack of information at project start, late equipment delivery, large group sizes, workload/reorganization, and limited/technical issues with equipment, while manager support could enable or hinder uptake.

IV. CONCLUSION

The implementation of an ergonomic multipurpose workstation setup, while offering clear health and productivity benefits, is often constrained by significant barriers and challenges such as entrenched sedentary work cultures, inadequate training, logistical issues in equipment delivery and placement, and limited organizational support. These obstacles highlight that simply providing ergonomic tools is insufficient; success depends on comprehensive strategies that address behavioral norms, ensure equitable access, offer continuous training, and secure managerial commitment. Without these supportive measures, the long-term adoption and effectiveness of ergonomic multipurpose workstations may be compromised, limiting their potential to improve workplace well-being and performance.

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