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THE ROLE OF ERGONOMICS IN WORKSTATION MANAGEMENT TO IMPROVE PRACTICAL PERFORMANCE OF SMK NEGERI 1 SINGOSARI STUDENTS: A SYSTEMATIC LITERATURE REVIEW

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ABSTRACT

This study aims to systematically review literature related to the role of ergonomics in workstation management to improve practical performance among students at SMK Negeri 1 Singosari. The systematic literature review method was utilized, involving the identification, evaluation, and synthesis of scholarly articles published between 2014 and 2024. Searches were conducted in reputable databases including Google Scholar, Scopus, ScienceDirect, SpringerLink, IEEE Xplore, and PubMed, using relevant keywords such as ergonomics, workstation management, vocational education, and student performance. Rigorous inclusion and exclusion criteria guided the selection of articles to ensure relevance, quality, and credibility. Analysis was performed thematically, categorizing findings into physical, cognitive, and organizational ergonomic factors. The results indicated that effective ergonomic practices significantly enhanced student comfort, concentration, safety, and productivity during practical learning activities. Supporting factors identified included adequate funding, administrative support, and increased ergonomic awareness, whereas barriers encompassed financial limitations, inadequate facilities, and resistance to change. This study underscores the importance of adopting ergonomically optimized environments to foster practical skill mastery and increased student motivation. Recommendations are provided for SMK Negeri 1 Singosari to integrate ergonomics more systematically, including curriculum-based ergonomic training, establishing ergonomic oversight committees, and fostering strategic collaborations to enhance student outcomes comprehensively.

Keywords: Ergonomics, Workstation Management, Vocational Education

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1. INTRODUCTION

The development of vocational education in Indonesia plays a crucial role in preparing students for the workforce. The increasing emphasis on vocational education reflects the government's recognition of the need for skilled labor to drive economic growth. The establishment and expansion of Vocational High Schools (Sekolah Menengah Kejuruan - SMK) are strategically aligned with the requirements of industries, aiming to produce graduates equipped with relevant competencies that meet the demands of the job market. For instance, Prabowo emphasizes that the development of vocational schools tailored to regional strengths is essential for enhancing both educational outcomes and regional competitiveness in Indonesia (Prabowo, 2021). This sentiment is echoed in the work of Syarifah et al., who assert that vocational schools should align their educational offerings with regional potential to effectively contribute to local development (Syarifah et al., 2019).

Vocational High Schools are critical in nurturing a workforce capable of fulfilling industry needs, especially in a rapidly changing economic landscape shaped by technological advancements. According to Misbah et al., vocational education shapes not just technical skills but holistic readiness for work, preparing students to engage with evolving industry demands and complexities (Misbah et al., 2019). Additionally, the character formation aspect highlighted by Noviansyah emphasizes the goal of creating graduates who are adaptable and capable of navigating the contemporary workforce environment (Noviansyah & Kurniawan, 2021). The curriculum, particularly with initiatives like Kurikulum Merdeka, reinforces the importance of tailoring education to meet these evolving needs, as indicated by Masbukhin and Sausan (Masbukhin & Sausan, 2023).

Furthermore, the call for high competence among graduates stems from the industrial world's demands for not only skilled but also innovative individuals who can contribute productively to their workplaces. Anwar and Sudira point out that the need for essential skills in the Industrial Revolution 4.0 necessitates that educators focus not only on imparting knowledge but on enhancing professional skills relevant to current and future industry requirements (Anwar & Sudira, 2022). This perspective is supported by Arsyad et al., who articulate that vocational education is not just about technical proficiency but encompasses fostering a mindset that aligns with economic growth (Arsyad et al., 2023). Similarly, Iskandar emphasizes the importance of vocational education in developing students' practical skills and work readiness (Iskandar, 2024).

The economic rationale for prioritizing vocational education stems from the belief that it acts as a bridge between formal education and labor market opportunities, as described by Mahirda and Wahyuni (Mahirda & Wahyuni, 2016). This view is reinforced by the observation that enhanced vocational training directly correlates with improved job readiness and employability, which in turn contributes to national economic stability and growth (Qurniawan & Jasmina, 2021). The substantial growth rate of SMK in Indonesia, with a noted 19.9% increase from 2012 to 2019, underscores the government's commitment to expanding vocational education as a response to labor market demands (Qurniawan & Jasmina, 2021).

Practical learning is a pivotal aspect of vocational education in Indonesia, particularly within Vocational High Schools (Sekolah Menengah Kejuruan, SMK). This model of education emphasizes hands-on experience and skill acquisition, which are essential for preparing students to meet the demands of the job market. According to Widiantara et al., practical learning constitutes approximately 70% of vocational education, providing students with applied skills necessary to fulfill industry requirements effectively Widiantara et al. (2022). The emphasis on practical learning allows for the cultivation of competencies that align with the expectations of employers, thereby enhancing graduates' employability and work readiness (ZHAO, 2023).

Moreover, the relationship between the quality of practical learning experiences and the development of student work competencies is well-established. Effective practical training

environments significantly contribute to students' ability to apply theoretical knowledge in real-world scenarios, which is fundamental for vocational education (ZHAO, 2023). Asikainen and Tapani assert that integrating educational practices focusing on student engagement leads to improved learning outcomes and better prepares students for entrepreneurial roles in their future careers (Asikainen & Tapani, 2021). In another study, Zhao elaborates on the importance of school-enterprise collaborations, which provide practical exposure and insight into real work situations, further enhancing the competencies attained through vocational education (ZHAO, 2023).

Despite the recognized importance of practical learning, several problems prevail within SMK. One of the most pressing issues includes the substandard conditions of practical workstations, which often do not meet ergonomic standards. Chang et al. highlight that inadequately designed workstations can hinder performance and adversely affect students' health, underscoring the need for proper ergonomic evaluations in educational settings (Chang et al., 2017). Research by Rodrigues et al. corroborates this, noting that poor ergonomic configurations are linked to increased incidences of musculoskeletal pain among office workers, suggesting that similar issues could arise in vocational settings where workstation design is neglected (Rodrigues et al., 2017).

Furthermore, there is a notable lack of awareness and attention among schools regarding the significance of ergonomic management in workshops and practical training environments. Mottaghi et al. examined how ergonomic interventions can improve cognitive function and overall performance, highlighting that well-designed work environments can lead to better student outcomes (Mottaghi et al., 2022). The absence of ergonomic considerations in practical learning setups in many SMK compromises the health and safety of students, which in turn affects their learning effectiveness. Al-Nakhli and Bakheet assert that improper body postures resulting from poorly designed workspaces can lead to long-term health complications, detrimentally impacting educational outcomes (Al-Nakhli & Bakheet, 2020). Consequently, prioritizing ergonomics within practical learning environments is not only advantageous for health but also integral to optimizing educational results and preparing competent future professionals.

The influence of ergonomics on the learning process and outcomes is a significant consideration in vocational education, particularly in enhancing the practical performance of students. Ignoring ergonomic principles can lead to a variety of adverse effects, including heightened risk of injury, physical fatigue, decreased concentration, and reduced productivity among students. According to a review by Soltaninejad et al., the neglect of ergonomic factors during learning, especially in post-pandemic educational settings, has been shown to negatively affect students' health and academic performance Soltaninejad et al. (2021). Similarly, Jabeen and Hussain emphasize that long durations spent in non-ergonomic seating can lead not only to physical health issues but also hinder cognitive engagement during class (Jabeen & Hussain, 2022). These observations underscore the critical importance of integrating ergonomic considerations into educational environments to foster optimal learning conditions.

Previous studies indicate that the application of ergonomic interventions can substantially enhance comfort, safety, and productivity in practical learning contexts. For example, Rodrigues et al. highlight that implementing ergonomic training can reduce musculoskeletal symptoms and improve overall work efficiency among individuals (Rodrigues et al., 2017). The findings from Partido's research demonstrate that awareness and training in ergonomics empower students to assess their ergonomic conditions effectively, improving their learning posture and reducing injury risks (Partido, 2017). Collectively, these studies affirm that ergonomics serves as a vital framework that can promote safer learning environments, leading to increased student satisfaction and productivity.

Practical learning conditions at SMK Negeri 1 Singosari present significant ergonomic challenges. The TKR program is designed to offer comprehensive training in vehicle maintenance and repair, necessitating practical workstations equipped with the necessary tools

and technologies. However, the conditions of the available practical workstations often fall short of ideal ergonomic standards. Many workstations are characterized by improper layouts, inadequate dimensions, suboptimal lighting, and insufficient ventilation, which directly affect students' ability to perform tasks effectively. For instance, Idkhan and Baharuddin emphasize the importance of structuring the work environment to enhance student comfort and facilitate skill acquisition within the practicum (Idkhan & Baharuddin, 2019).

Students face various challenges during practical exercises related to the ergonomics of their workstations. These include awkward workstation configurations that require them to adopt poor postures, leading to fatigue and discomfort. Although Chang et al.'s study focuses on ergonomic evaluations in different contexts, it highlights the significance of assessing workstation dimensions to prevent injuries, which may also apply to educational settings (Chang et al., 2017). Furthermore, insufficiently designed work environments can disrupt students' focus and engagement, ultimately impeding their learning outcomes. As illustrated by Lasota, ergonomic evaluations are crucial in recognizing risks and making necessary adjustments to enhance productivity in educational settings (Lasota, 2020).

The urgency of implementing ergonomics at SMK Negeri 1 Singosari stems from the vital need for ergonomics-based workstation management to enhance the efficiency of students' practical learning processes. As vocational education increasingly emphasizes hands-on training, proper ergonomic principles become essential for ensuring that students can perform tasks effectively and safely without unnecessary strain or injury. According to (Shahwan et al., 2021), adopting ergonomic standards can mitigate risks, such as musculoskeletal disorders and visual fatigue, by ensuring that workstations are designed to fit user needs (Shahwan et al., 2021). Furthermore, developing a proactive ergonomics strategy implies the necessity of evaluating current workstation layouts and protocols to enhance educational outcomes.

The implications of ergonomics are profound, particularly concerning improving student practical performance. Ergonomically optimized work environments are known to foster higher productivity, accuracy, comfort, and work safety among students. Previous research has indicated that ergonomic interventions lead to increased comfort, which, in turn, enhances concentration and work output. Rodrigues et al. (2017) highlight that poor workstation adjustments contribute to various musculoskeletal issues, significantly detracting from work efficiency in educational settings (Rodrigues et al., 2017). Hence, creating ergonomically sound workplaces not only prevents injuries but also promotes a more engaging learning environment where students can focus on skill mastery.

At SMK Negeri 1 Singosari, practical learning conditions, particularly within the Light Vehicle Engineering (Teknik Kendaraan Ringan, TKR) expertise program, require immediate attention. The TKR program is geared towards equipping students with essential skills in vehicle repair and maintenance, necessitating a well-designed practical environment. However, existing workstations often lack proper ergonomic arrangements, leading to suboptimal conditions for students. Issues such as inappropriate workstation dimensions, ineffective equipment arrangement, insufficient lighting, and inadequate ventilation can significantly hinder students' ability to engage effectively in practical exercises (Saptiansyah et al., 2023).

Students in the TKR program typically face specific challenges during practical sessions, stemming from workstation deficiencies that compromise their comfort and safety. Marín and Marín (2021) emphasize that unsuitable designs lead to physical discomfort, reduced focus, and ultimately lower educational performance (Marín & Marín, 2021). Moreover, consistent exposure to poorly designed learning environments increases the likelihood of developing chronic musculoskeletal conditions, which can severely impact long-term career prospects and job satisfaction. Furthermore, implementing ergonomic strategies that address these workstation challenges can substantially enhance the learning experience and outcomes by

ensuring that students maintain appropriate postures and work efficiently (Nizam & Ramlee, 2024).

2. METHODS

This study employs the Systematic Literature Review (SLR) method, aiming to systematically collect, evaluate, and synthesize relevant research literature concerning the role of ergonomics in workstation management to enhance the practical performance of students at SMK Negeri 1 Singosari. The systematic approach allows for structured findings that provide evidence-based insights into vocational education and ergonomics. The SLR process follows several stages aligned with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. Initially, research questions were formulated clearly and concisely, focusing on three primary inquiries: (1) How does ergonomics influence students' practical performance in vocational education settings? (2) What factors facilitate or hinder the implementation of ergonomics in vocational school workstations? (3) Which ergonomic strategies are most effective in enhancing student productivity and safety in vocational practice environments?.

Literature searches were conducted through credible academic databases, including Google Scholar, Scopus, ScienceDirect, SpringerLink, IEEE Xplore, and PubMed. Keywords utilized in the search were "Ergonomics in vocational education," "Workstation management in SMK," "Ergonomic practices in technical schools," "Effect of ergonomics on student performance," "Occupational safety in vocational education," and "Ergonomics in workshop-based learning." Selection criteria consisted of clearly defined inclusion and exclusion standards. Articles included were published within the period of 2014–2024 to ensure the relevance of recent studies, directly discussed ergonomics in vocational educational contexts, specifically within vocational high schools, employed clear and transparent quantitative, qualitative, or mixed-method approaches, and examined the connection between ergonomics and student performance in laboratory or workshop settings. Exclusion criteria involved studies not addressing ergonomics in educational or vocational high school contexts, articles exclusively discussing ergonomics within industrial settings unrelated to educational contexts, and studies lacking transparency or empirical data clarity.

The study selection and quality evaluation process adhered to the PRISMA guidelines. Selected articles underwent rigorous quality assessment utilizing established appraisal tools such as the Critical Appraisal Skills Programme (CASP) and Joanna Briggs Institute (JBI) Critical Appraisal Checklist to ensure credibility and relevance. Data analysis involved thematic synthesis to identify patterns, trends, and relationships between ergonomics and student performance. Data extracted from selected studies were summarized and categorized based on ergonomics aspects physical, cognitive, and organizational and their impacts on student practical performance.

To maintain the validity and reproducibility of this research, all methodological procedures were transparently documented following PRISMA guidelines, accompanied by a comprehensive list of the analyzed studies as supplementary materials. This systematic method is expected to yield comprehensive insights regarding the role of ergonomics in improving practical student performance and offer evidence-based recommendations for improved workstation management in vocational education contexts, specifically at SMK Negeri 1 Singosari.

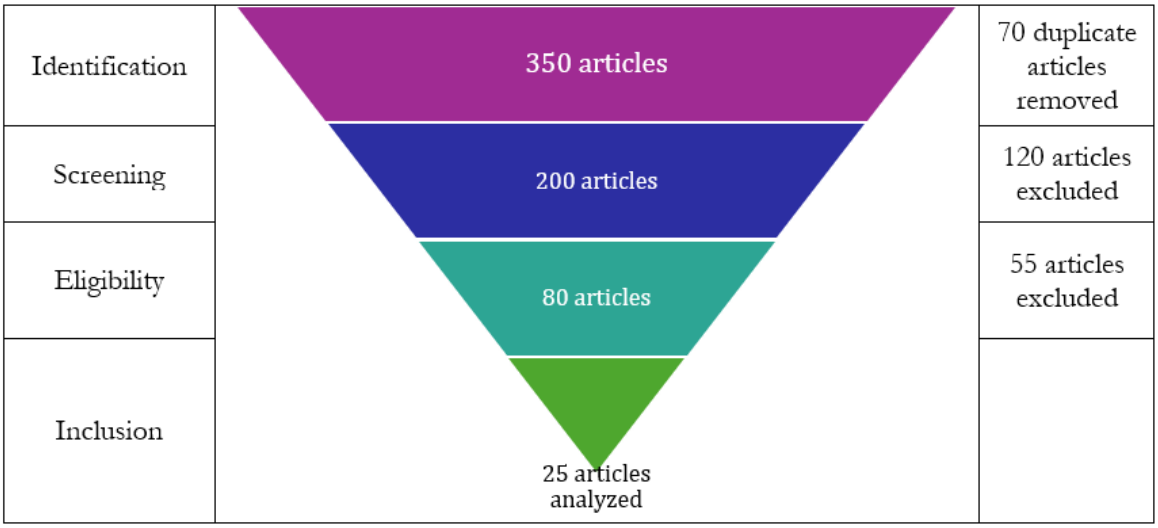

Figure 1. PRISMA diagram for the Systematic Literature Review (SLR) process

Data extraction was conducted using a pre-defined coding framework to ensure consistency. Each selected article was reviewed independently by two researchers who extracted information related to ergonomic type (physical, cognitive, organizational), intervention type, outcomes, and context. A thematic analysis was conducted through iterative coding, in which emergent patterns were grouped and categorized into overarching themes. For instance, discomfort reduction and improved concentration emerged repeatedly in studies involving workstation redesign, which were grouped under the physical ergonomics theme. This approach enhances transparency and replicability of findings.

3. FINDINGS AND DISCUSSION

3.1. Findings

This section presents the findings of the Systematic Literature Review (SLR), which aimed to explore the role of ergonomics in various professional and educational settings. The reviewed studies provide empirical evidence on the impact of ergonomic interventions, training programs, risk assessments, and cognitive ergonomics strategies. A total of 25 selected articles were analyzed systematically to extract key findings relevant to the study.

The studies encompass a wide range of industries, including healthcare, vocational education, industrial workspaces, cognitive ergonomics, and dental ergonomics. Several recurring themes emerged from the literature:

1) Workplace Ergonomics and Health Risks

Many studies highlight the prevalence of musculoskeletal disorders among professionals due to poor ergonomic conditions. Research by Epstein et al. (2018) found a high prevalence of work-related musculoskeletal disorders among surgeons, emphasizing the need for better ergonomic interventions. Similarly, Mohammadipour et al. (2018) identified poor ergonomic postures as a leading cause of musculoskeletal discomfort among office workers.

2) Ergonomic Training and Awareness

Several studies emphasize the importance of ergonomic education and training. Hamid et al. (2022) demonstrated that ergonomic training significantly improves nurses' knowledge and workplace safety. However, Moosa & Bhayat (2022) noted a lack of ergonomic awareness among South African dental students, which affects their professional well-being.

3) Cognitive Ergonomics and Performance

Research has shown that ergonomics not only improves physical well-being but also cognitive performance. Kazemi & Smith (2022) examined how the COVID-19 pandemic underscored the need for improved cognitive ergonomics strategies. Similarly, Koirala & Maharjan (2022) found that cognitive ergonomics plays a crucial role in employee well-being and job satisfaction.

4) Ergonomics in Education and Vocational Training

Studies also focus on the application of ergonomics in vocational education and student competency development. Jabeen & Hussain (2022) reported that teachers lack awareness of ergonomic best practices in school environments. Meanwhile, Partido (2017) highlighted how self-assessment in ergonomics can improve students' postures and learning outcomes.

5) Industry-Specific Ergonomic Applications

Several studies explored industry-specific ergonomic solutions, such as ergonomic risk evaluation in multi-purpose workplaces (Lasota, 2020), ergonomic interventions in electronic industries (Nizam & Ramlee, 2024), and kitchen ergonomics in culinary settings (Ismail et al., 2020). These findings indicate that ergonomic strategies must be tailored to industry-specific challenges.

The findings extracted from the 25 selected studies are summarized in the following table

Table 1. SLR Findings Table

No	Author(s)	Title	Year
1	Epstein et al.	Prevalence of work-related musculoskeletal disorders among surgeons and interventionalists	2018
2	Hamid et al.	Effect of ergonomics training program on nurses' knowledge and safety practice	2022
3	Idkhan & Baharuddin	Comfort temperature and lighting intensity: ergonomics of laboratory room machine tools	2019
4	Iskandar	Assessors in the South Sulawesi provincial level vocational school student competency competition	2024
5	Ismail et al.	Ergonomics kitchen: a better place to work	2020
6	Jabeen & Hussain	Teachers' awareness and practices on school ergonomics in Karachi, Pakistan	2022
7	Kalakoski et al.	Effects of a cognitive ergonomics workplace intervention on cognitive strain and well-being	2020
8	Kazemi & Smith	Overcoming COVID-19 pandemic: emerging challenges of human factors and the role of cognitive ergonomics	2022
9	Koirala & Maharjan	Cognitive ergonomics on employee wellbeing: a literature review	2022
10	Korhan et al.	Ergonomics - new insights	2023
11	Lasota	A new approach to ergonomic physical risk evaluation in multi-purpose workplaces	2020
12	Mahirda & Wahyuni	Returning to general and vocational high-schools in Indonesia	2016
13	Marín & Marín	Forces: a motion capture-based ergonomic method for today's world	2021
14	Mary et al.	Knowledge, attitude and practice of ergonomics among dental students: a cross-sectional pilot study	2023
15	Masbukhin & Sausan	Analyzing the implementation of Kurikulum Merdeka: insights from chemistry educators	2023
16	Misbah et al.	Evaluating competence-based vocational education in Indonesia	2019
17	Mohammadipour et al.	Work-related musculoskeletal disorders in Iranian office workers: prevalence and risk factors	2018

No	Author(s)	Title	Year
18	Moosa & Bhayat	The ergonomic knowledge and practice of dental students in a tertiary institution in South Africa	2022
19	Mottaghi et al.	Effect of ergonomic intervention on cognitive function of office workers	2022
20	Nizam & Ramlee	Ergonomic risk factors and job performance of electronic employees in Malaysia	2024
21	Noviansyah & Kurniawan	School culture that supports graduate competency development: a case study at SMK PIKA Semarang	2021
22	Nurhesti et al.	Improving cancer-related fatigue management through ergonomic workshops	2023
23	Ogondiek	Formative assessment practices and its effect on employability skills to vocational students in Tanzania	2024
24	Partido	Dental hygiene students' self-assessment of ergonomics utilizing photography	2017
25	Pierce et al.	Evaluating the current state of ergonomics education offered to students in US medical students	2022

3.2. Discussion

3.2.1 The Role of Ergonomics in Workstation Management

Physical ergonomics plays a crucial role in enhancing students' comfort and safety at their respective workstations. Research indicates that ergonomic modifications, such as the use of properly designed chairs and desks, can significantly reduce discomfort associated with improper posture and repetitive strain injuries (Korhan et al., 2023; Al-Hinai et al., 2018). For instance, a systematic redesign of the learning environment to align with ergonomic principles can minimize the risk of musculoskeletal disorders, which are prevalent among students (Soltaninejad et al., 2021). Effective ergonomics considers factors such as workstation layout, storage accessibility, and the physical design of learning materials to facilitate a safer and more comfortable educational experience (Bakry et al., 2022). Moreover, ergonomic standards in school environments, including adherence to appropriate equipment and furniture, contribute positively to students' health, thus supporting a conducive learning atmosphere. Such environments not only promote safety but also enhance overall student satisfaction and educational outcomes (Biswas, 2023).

Cognitive ergonomics focuses on optimizing the interplay between cognitive processes and workstation design, which directly affects students' concentration and learning effectiveness. Research highlights that a well-designed cognitive environment can mitigate mental fatigue and enhance cognitive engagement, leading to improved learning outcomes (Kazemi & Smith, 2022; Said et al., 2023). Students perform better when their cognitive workload is balanced with appropriate task demands, thereby reducing instances of overload and distraction (Sabauri, 2024). Additionally, the integration of cognitive ergonomic principles in classroom design such as clear visual displays, intuitive organizational structures of learning materials, and minimal distractions fosters an environment that encourages active engagement and enhances the retention of information (Kalakoski et al., 2020; Shi et al., 2024). This alignment not only aids concentration but also fortifies understanding in complex subjects, enabling a more robust educational experience.

Organizational ergonomics encompasses the design of work systems, processes, and roles within an educational context. Focusing on ergonomics at an organizational level facilitates efficient time management and increases productivity among students. In particular, effective organizational ergonomics incorporates systematic approaches to workload distribution, communication protocols, and collaborative learning frameworks, significantly influencing students' ability to manage their time effectively (Koirala & Maharjan, 2022; Adelino et al., 2024). Studies suggest that implementing ergonomic strategies within educational institutions allows

for improved student participation, better resource allocation, and enhanced task coordination, all of which contribute to higher productivity levels in academic settings (Pouyakian, 2022). Establishing a supportive organization that emphasizes ergonomic awareness further empowers students to autonomously apply ergonomic principles in their study habits, promoting a culture of health and efficiency over time (Nizam & Ramlee, 2024).

3.2.2 The Relationship Between Ergonomics and Practical Performance of SMK Students

The configuration of workstations significantly impacts students' practical skills and results. Several studies illustrate that well-designed ergonomic workstations can lead to improved technical competence among students. For example, ergonomic interventions in the design of laboratory workstations have shown to reduce complaints related to musculoskeletal disorders while enhancing user comfort, which is crucial for effective learning and skill acquisition (Saptiansyah et al., 2023). Furthermore, ergonomic optimization focuses on aligning workstation dimensions with students' anthropometric data, leading to a reduction in discomfort and an increase in practical performance during hands-on activities (Saptiansyah et al., 2023). Research conducted by Boadi-Kusi et al. highlights that inadequate ergonomics at workstations can impede the acquisition of technical skills due to increased discomfort and a higher incidence of work-related injuries (Boadi-Kusi et al., 2020). Students who operate in ergonomically optimized environments, conversely, exhibit enhanced focus and greater readiness to engage in practical tasks. A systematic review indicates a positive association between ergonomic workstation design and skill proficiency, confirming that reducing physical strain fosters a better learning experience (Saptiansyah et al., 2023). Moreover, the design and layout of ergonomic workstations serve as foundational elements that promote skill development. Enhancing workstation attributes including chair comfort, desk height, and tool accessibility can positively influence students' ability to engage with practical exercises effectively, thereby refining their technical skills and enhancing their educational outcomes (Marín & Marín, 2021; Boulila et al., 2018).

The integration of ergonomic principles into workstation design extends beyond physical comfort; it significantly influences students' motivation and engagement in their learning activities. Ergonomically crafted spaces are associated with improved mental clarity, reduced fatigue, and thus increased motivation to learn (Mohammadipour et al., 2018; Seva et al., 2021). Studies indicate that when students are mindful of their comfort level at workstations, there is a noticeable increase in their intrinsic motivation to engage in educational tasks, leading to enhanced satisfaction with their learning experiences (Alyan et al., 2020). For instance, research suggests that workstation design that responds to ergonomic needs has a direct correlation to enhanced learning motivation, as students are likely to feel more empowered and focused in environments tailored to their own physical requirements (Mohammadipour et al., 2018; Alyan et al., 2020). Moreover, ergonomic training and awareness as part of the educational curriculum can further bolster students' motivation by making them cognizant of the importance of ergonomics in both academic and professional settings, thus encouraging them to adopt healthier work habits (Seva et al., 2021). Furthermore, ergonomic interventions, such as optimizing workstation layouts and providing proper training on their usage, contribute significantly to a more immersive learning environment. As students engage in comfortable and efficient workspaces, their psychological association of the learning environment with positive experiences increases, thus elevating their motivation levels (Alyan et al., 2020; Ogondiek, 2024). Similarly, research indicates z that the organization of the workspace including the arrangement of tools and equipment plays a pivotal role in motivating students to maintain focus and productivity during practical tasks. By alleviating unnecessary distractions through good ergonomic practices, students can devote their energy to mastering complex skills (Mohammadipour et al., 2018; DB et al., 2016).

3.2.3 Supporting and Inhibiting Factors of Ergonomics Implementation

Ergonomic implementation benefits significantly from various supporting factors, including adequate resources, management support, and increased ergonomic awareness among students and educators. Resources, such as funding for ergonomic equipment and training programs, are foundational for successful ergonomics initiatives. Studies show that sufficient resources can lead to improved ergonomic conditions that enhance performance and decrease injury incidence Choi & Brings (2016). Furthermore, management support plays a critical role in creating a culture that prioritizes ergonomics; leaders who actively champion ergonomic practices foster an environment where both faculty and students understand the importance of ergonomic principles (Epstein et al., 2018). Another essential aspect is the level of ergonomic awareness within the educational community. Research indicates that students and faculty members well-versed in ergonomic principles are more likely to adopt safe and efficient workplace practices, which enhance productivity and reduce discomfort and injury (Ismail et al., 2020; Ephraim-Emmanuel et al., 2019). For instance, proactive ergonomic training and educational programs increase knowledge and positive attitudes towards ergonomics, leading to better adherence to ergonomic best practices (Pinto et al., 2018).

Conversely, several inhibiting factors hinder the implementation of ergonomic practices in educational settings. One major issue is the cost associated with ergonomic interventions. Financial constraints often limit schools from investing in necessary ergonomic equipment or extensive training programs, which can thwart efforts to improve workstation ergonomics. Studies indicate that the high initial costs of ergonomic implementation can deter institutions from making necessary changes (Shokunbi & George, 2015). Limited facilities also pose a significant challenge for effective ergonomic implementation. Insufficient space or outdated equipment can restrict the ability to redesign workstations according to ergonomic principles. As noted by Ephraim-Emmanuel et al., lack of physical infrastructure adversely affects the adoption of ergonomic practices, as educators and students may not have appropriate tools to apply ergonomic guidelines effectively (Tysiąc-Miśta et al., 2024; Pierce et al., 2022). Moreover, resistance to change within the institution can significantly impede ergonomic initiatives. Individuals accustomed to traditional practices may be hesitant to adopt new ergonomic strategies, and this resistance can arise from both a lack of understanding and ingrained habits (ALHazim et al., 2022).

3.2.4 Implications of Research Results for SMK Negeri 1 Singosari

The findings of this systematic review bear significant implications for SMK Negeri 1 Singosari, particularly in terms of practical recommendations and strategic actions that can be undertaken to enhance ergonomic workstation management.

The findings of this systematic review bear significant implications for SMK Negeri 1 Singosari, particularly in terms of practical recommendations and strategic actions that can be undertaken to enhance ergonomic workstation management.

Strategically, SMK Negeri 1 Singosari should consider the establishment of a dedicated ergonomic committee tasked with overseeing the implementation of ergonomic practices within the school. This committee would be responsible for assessing current ergonomic conditions, identifying areas for improvement, and coordinating training and awareness programs (Mary et al., 2023). Furthermore, fostering partnerships with local businesses or ergonomic specialists can provide additional resources and expertise to support ergonomic initiatives, enhancing the overall effectiveness of workplace ergonomics at the school (Bonutto et al., 2020). Promoting a culture that values ergonomics is crucial for sustaining long-term improvements. This involves continual reinforcement of the benefits of ergonomics through regular workshops, informational sessions, and feedback mechanisms that encourage engagement from both staff and students (Sarfaraz et al., 2020). Additionally, leveraging technology to disseminate ergonomic best practices and gather feedback could facilitate an adaptive approach to ergonomic management at SMK Negeri 1 Singosari, ensuring that the needs and concerns of all stakeholders are addressed (Nurhesti et al., 2023).

3.3 Limitations of the Study:

This review acknowledges several limitations. First, the exclusion of non-English studies may have resulted in language bias. Second, despite employing rigorous criteria, potential selection bias remains due to reliance on database-indexed articles, possibly omitting relevant gray literature. Third, while diverse educational contexts were included, generalizability to all vocational institutions in Indonesia should be approached with caution. Additionally, the thematic synthesis may inherently reflect interpretative subjectivity, although mitigated by dual-reviewer validation. These limitations highlight the need for further empirical studies focused directly on ergonomic interventions within vocational school contexts in Indonesia.

4.CONCLUSION AND SUGGESTION

This systematic literature review underscores the critical role of ergonomics in workstation management to improve the practical performance of SMK Negeri 1 Singosari students, particularly in vocational education contexts. It reveals that effective ergonomic practices positively influence physical comfort, cognitive function, and organizational efficiency, leading to significant improvements in student productivity and skill mastery. The review highlights the necessity of integrating ergonomic principles into the school's learning environment, as neglecting ergonomics can result in increased health risks, reduced student motivation, and diminished educational outcomes. Key supporting factors for successful ergonomics implementation include adequate resource allocation, strong management support, and heightened ergonomic awareness within the school community. Conversely, the main barriers identified were financial constraints, limited facilities, and resistance to change among educators and students. A new hypothesis emerging from this study suggests that ergonomic training directly integrated into the curriculum could significantly enhance student engagement and long-term learning retention. Therefore, SMK Negeri 1 Singosari is recommended to establish a dedicated ergonomic committee to oversee ongoing improvements in workstation ergonomics. Collaborating with ergonomic specialists and industry stakeholders will further enrich the practical learning experience, aligning student competencies closely with real-world demands. Ultimately, fostering an ergonomically sound educational setting will not only enhance students' immediate practical performance but also prepare them comprehensively for future career challenges.

Based on the findings, it is hypothesized that embedding ergonomics education into the vocational curriculum not only enhances student comfort and safety but also improves cognitive engagement and long-term learning outcomes. Future studies may empirically test this hypothesis through experimental designs in vocational classroom settings.

References

Adelino, M., Zadry, H. and Susanti, L. 2024. 'Contemporary trends in human factors and ergonomics within engineering research', Jurnal Teknik Industri, 26(1), pp. 61-76. doi:10.9744/jti.26.1.61-76.

ALHazim, S., Al-Otaibi, S. and Herzallah, N. 2022. 'Knowledge, attitudes, and practices regarding ergonomic hazards among healthcare workers in a Saudi government hospital', Journal of Multidisciplinary Healthcare, 15, pp. 1771-1778. doi:10.2147/jmdh.s371361.

Al-Hinai, N., Al-Kindi, M. and Shamsuzzoha, A. 2018. 'An ergonomic student chair design and engineering for classroom environment', International Journal of Mechanical Engineering and Robotics Research, 7(5), pp. 534-543. doi:10.18178/ijmerr.7.5.534-543.

Al-Nakhli, H. and Bakheet, H. 2020. 'The impact of improper body posture on office workers' health', International Journal of Innovative Research in Medical Science, 5(05). doi:10.23958/ijirms/vol05-i05/873.

Alyan, E., Saad, M. and Kamel, N. 2020. 'Effects of workstation type on mental stress: fNIRS study', Human Factors: The Journal of the Human Factors and Ergonomics Society, 63(7), pp. 1230-1255. doi:10.1177/0018720820913173.

Anu, V., Babu, A. and Kumar, P. 2018. 'Insights about dental ergonomics among dental students: The need of the hour to recommend dental ergonomics in academic

curriculum', Journal of Advanced Oral Research, 9(1-2), pp. 49-54. doi:10.1177/2320206818812538.

Anwar, C. and Sudira, P. 2022. 'Literacy of vocational high school teachers majoring in automotive light vehicle engineering: The need for essential skills in the industrial revolution 4.0', Journal of Education Technology, 6(4), pp. 625-633. doi:10.23887/jet.v6i4.46580.

Arsyad, J., Ambiyar, A., Jalinus, N., Fadhilah, F. and Abdullah, R. 2023. 'The role of the business world industry through a teaching practice program in increasing the competence of vocational school graduates', Jurnal Sains dan Teknologi Industri, 20(2), p. 899. doi:10.24014/sitekin.v20i2.20985.

Asikainen, E. and Tapani, A. 2021. 'Exploring the connections of education for sustainable development and entrepreneurial education—a case study of vocational teacher education in Finland', Sustainability, 13(21), p. 11887. doi:10.3390/su132111887.

Bakry, H., Alrasheed, N., Alqahtani, S., Alshahri, R., Alburaidi, G. and Almoayad, F. 2022. 'Ergonomic perceptions and practices among students in e-learning during COVID-19', International Journal of Learning, Teaching and Educational Research, 21(9), pp. 348-369. doi:10.26803/ijlter.21.9.20.

Biswas, S. 2023. 'Design studio insights: Anthropometric considerations for ergonomic design of wet services', Journal of Design Studio, 5(1), pp. 73-84. doi:10.46474/jds.1292295.

Boadi-Kusi, S., Abu, S., Acheampong, G., Adueming, P. and Abu, E. 2020. 'Association between poor ergophthalmologic practices and computer vision syndrome among university administrative staff in Ghana', Journal of Environmental and Public Health, 2020, pp. 1-8. doi:10.1155/2020/7516357.

Bonutto, N., Kennedy, N. and Quinton, A. 2020. 'Musculoskeletal pain amongst Australian sonography students and recent graduates and an evaluation of the use of ergonomic education for prevention', Australasian Journal of Ultrasound in Medicine, 23(4), pp. 238-247. doi:10.1002/ajum.12227.

Boulila, A., Ayadi, M. and Mrabet, K. 2018. 'Ergonomics study and analysis of workstations in Tunisian mechanical manufacturing', Human Factors and Ergonomics in Manufacturing & Service Industries, 28(4), pp. 166-185. doi:10.1002/hfm.20732.

Chang, S., Yoon, H. and Cheng, H. 2017. 'A case study of ergonomic evaluation for the control rooms of a petroleum complex', Journal of the Ergonomics Society of Korea, 36(1), pp. 1-7. doi:10.5143/jesk.2017.36.1.1.

Choi, S. and Brings, K. 2016. 'Work-related musculoskeletal risks associated with nurses and nursing assistants handling overweight and obese patients: A literature review', Work, 53(2), pp. 439-448. doi:10.3233/wor-152222.

DB, K., KO, A., DE, A., Ankamah, E. and EA, O. 2016. 'Ergonomic challenges of employees using computers at work in a tertiary institution in Ghana', Optometry Open Access, 01(02). doi:10.4172/2476-2075.1000107.

Ephraim-Emmanuel, B., Ogbomade, R., Idumesaro, B. and Ugwoke, I. 2019. 'Knowledge, attitude and practice of preventing the occurrence of work-related musculoskeletal disorders among doctors in University of Port-Harcourt Teaching Hospital', Journal of Medical Research and Innovation, e000161. doi:10.32892/jmri.161.

Epstein, S., Sparer, E., Tran, B., Ruan, Q., Dennerlein, J., Singhal, D., et al. 2018. 'Prevalence of work-related musculoskeletal disorders among surgeons and interventionalists', JAMA Surgery, 153(2), e174947. doi:10.1001/jamasurg.2017.4947.

Hamid, A., Fekry, N. and Etway, E. 2022. 'Effect of ergonomics training program on nurses' knowledge and safety practice', International Journal of Health Sciences, pp. 5992-6006. doi:10.53730/ijhs.v6ns6.11195.

Idkhan, A. and Baharuddin, F. 2019. 'Comfort temperature and lighting intensity: ergonomics of laboratory room machine tools', International Journal of Environment Engineering and Education, 1(2), pp. 53-58. doi:10.55151/ijeedu.v1i2.15.

Iskandar, A. 2024. 'Assessors in the South Sulawesi provincial level vocational school student competency competition (LKS)', J.

Abdimas Cendekiawan Indones., 1(2), pp. 14-20. doi:10.56134/jaci.v1i2.89.

Ismail, F., Osman, S. and Rahman, F. 2020. 'Ergonomics kitchen: a better place to work', International Journal of Academic Research in Business and Social Sciences, 11(13). doi:10.6007/ijarbss/v11-i13/8501.

Jabeen, R. and Hussain, N. 2022. 'Teachers' awareness and practices on school ergonomics in Karachi, Pakistan', Biological and Clinical Sciences Research Journal, 3(1), pp. 366-381. doi:10.47264/idea.jhsms/3.1.26.

Kalakoski, V., Selinheimo, S., Valtonen, T., Turunen, J., Käpykangas, S., Ylisassi, H., et al. 2020. 'Effects of a cognitive ergonomics workplace intervention (COGERG) on cognitive strain and well-being: a cluster-randomized controlled trial. A study protocol', BMC Psychology, 8(1). doi:10.1186/s40359-019-0349-1.

Kazemi, R. and Smith, A. 2022. 'Overcoming COVID-19 pandemic: emerging challenges of human factors and the role of cognitive ergonomics', Theoretical Issues in Ergonomics Science, 24(4), pp. 401-412. doi:10.1080/1463922x.2022.2090027.

Koirala, R. and Maharjan, K. 2022. 'Cognitive ergonomics on employee wellbeing: a literature review', J. Econ. Concerns, 13(1), pp. 93-106. doi:10.3126/tjec.v13i1.57064.

Korhan, O., Odebiyi, D., Arinze, U., Okafor, C., Erick, P., Tumoyagae, T., et al. 2023. 'Ergonomics - new insights', IntechOpen. doi:10.5772/intechopen.102238.

Lasota, A. 2020. 'A new approach to ergonomic physical risk evaluation in multi-purpose workplaces', Tehnicki Vjesnik - Technical Gazette, 27(2). doi:10.17559/tv-20180312131319.

Mahirda, K. and Wahyuni, H. 2016. 'Returning to general and vocational high-schools in Indonesia', Review of Economic and Business Studies, 9(2), pp. 9-28. doi:10.1515/rebs-2016-0031.

Marín, J. and Marín, J. 2021. 'Forces: a motion capture-based ergonomic method for today's world', Sensors, 21(15), p. 5139. doi:10.3390/s21155139.

Mary, A., Kesavan, R., Vaishnavi, V., Jessica, V., Vadllamudi, Y. and Tabasum, M. 2023. 'Knowledge, attitude and practice of ergonomics among dental students: a cross-sectional pilot study', International Journal of Applied Dental Sciences, 9(4), pp. 294-298. doi:10.22271/oral.2023.v9.i4e.1883.

Masbukhin, F. and Sausan, I. 2023. 'Analyzing the implementation of Kurikulum Merdeka: insights from chemistry educators in Gunung Kidul vocational schools', Jurnal Penelitian Pendidikan IPA, 9(12), pp. 11250-11260. doi:10.29303/jppipa.v9i12.5991.

Misbah, Z., Gulikers, J., Dharma, S. and Mulder, M. 2019. 'Evaluating competence-based vocational education in Indonesia', Journal of Vocational Education and Training, 72(4), pp. 488-515. doi:10.1080/13636820.2019.1635634.

Mohammadipour, F., Pourranjbar, M., Naderi, S. and Rafie, F. 2018. 'Work-related musculoskeletal disorders in Iranian office workers: prevalence and risk factors', Journal of Medicine and Life, 11(4), pp. 328-333. doi:10.25122/jml-2018-0054.

Moosa, U. and Bhayat, A. 2022. 'The ergonomic knowledge and practice of dental students in a tertiary institution in South Africa', International Journal of Dentistry, 2022, pp. 1-5. doi:10.1155/2022/4415709.

Mottaghi, Z., Halvani, G., Jambarsang, S. and Mehrparvar, A. 2022. 'Effect of ergonomic intervention on cognitive function of office workers', Preprint. doi:10.21203/rs.3.rs-1419960/v1.

Nizam, N. and Ramlee, S. 2024. 'Ergonomic risk factors and job performance of electronic employees in Malaysia', Malaysian Journal of Medicine and Health Sciences, 20(1), pp. 112-118. doi:10.47836/mjmhs.20.1.15.

Noviansyah, W. and Kurniawan, I. 2021. 'School culture that supports graduate competency development: a case study at SMK PIKA Semarang', ASEAN Social Science and Humanities Research (ASSEHR). doi:10.2991/assehr.k.210204.040.

Nurhesti, P., Adiputra, N., Adiatmika, I. and Tirtayasa, K. 2023. 'Improving cancer-related fatigue management through ergonomic workshops', Journal of a Sustainable Global South, 7(1), p. 14. doi:10.24843/jsgs.2023.v07.i01.p04.

Ogondiek, M. 2024. 'Formative assessment practices and its effect on employability

skills to vocational students in Tanzania', JIPE, 16. doi:10.61538/jipe.v16i.1438.

Partido, B. 2017. 'Dental hygiene students' self-assessment of ergonomics utilizing photography', Journal of Dental Education, 81(10), pp. 1194-1202. doi:10.21815/jde.017.077.

Pierce, S., Heiman, A. and Ricci, J. 2022. 'Evaluating the current state of ergonomics education offered to students in US medical students', The American Surgeon, 89(5), pp. 1798-1806. doi:10.1177/00031348211063555.

Pinto, A., Tereso, M. and Abrahão, R. 2018. 'Práticas ergonômicas em um grupo de indústrias da região metropolitana de Campinas: natureza, gestão e atores envolvidos', Gestão & Produção, 25(2), pp. 398-409. doi:10.1590/0104-530x2226-16.

Pouyakian, M. 2022. 'Cybergonomics: proposing and justification of a new name for the ergonomics of industry 4.0 technologies', Frontiers in Public Health, 10. doi:10.3389/fpubh.2022.1012985.

Prabowo, T. 2021. 'Identification of vocational high school competency based on leading potential of the region in Batu City', Teknologi dan Kejuruan: Jurnal Teknologi Kejuruan dan Pengajarannya, 44(2), p. 118. doi:10.17977/um031v44i22021p118-123.

Qurniawan, R. and Jasmina, T. 2021. 'The effect of general and vocational high school quality on labor market outcomes in Indonesia', The Journal of Indonesia Sustainable Development Planning, 2(3), pp. 307-323. doi:10.46456/jisdep.v2i3.194.

Rodrigues, M., Leite, R., Lelis, C. and Chaves, T. 2017. 'Differences in ergonomic and workstation factors between computer office workers with and without reported musculoskeletal pain', Work, 57(4), pp. 563-572. doi:10.3233/wor-172582.

Sabauri, T. 2024. 'Conceptual aspects of cognitive ergonomics and job design', Human Resource Management & Services, 6(3), p. 3478. doi:10.18282/hrms.v6i3.3478.

Said, R., El-Bayaa, M., El-Henawy, W. and Bassuony, J. 2023. 'Using ergonomics-based instruction in teaching English language integrated skills', Port Said Journal of Educational Research, 2(1), pp. 105-131. doi:10.21608/psjer.2023.181595.1013.

Saptiansyah, R., Haqi, D. and Juwono, K. 2023. 'Proposed workstation design in laboratory for musculoskeletal disorder complaints', The Indonesian Journal of Occupational Safety and Health, 12(3), pp. 382-390. doi:10.20473/ijosh.v12i3.2023.382-390.

Sarfaraz, S., Gore, M., Askari, M., Imran, S., Khurshid, Z. and Adnan, S. 2020. 'Assessing insights and practices among graduates to signify the need for dental ergonomics within the dental curriculum: a cross-sectional survey', European Dental Research and Biomaterials Journal, 1(2), pp. 51-56. doi:10.1055/s-0040-1721538.

Seva, R., Tejero, L. and Fadrilan-Camacho, V. 2021. 'Barriers and facilitators of productivity while working from home during pandemic', Journal of Occupational Health, 63(1). doi:10.1002/1348-9585.12242.

Shahwan, B., D'emeh, W. and Yacoub, M. 2021. 'Evaluation of computer workstations ergonomics and its relationship with reported musculoskeletal and visual symptoms among university employees in Jordan', International Journal of Occupational Medicine and Environmental Health, 35(2), pp. 141-156. doi:10.13075/ijomeh.1896.01822.

Shi, J., Yusof, I. and Yahaya, M. 2024. 'Examining the relationship between innovative product design, cognitive ergonomics, and the effectiveness of entity design-system: focusing on the environment of big data-driven interface', Journal of Information Systems Engineering & Management, 9(3), p. 29049. doi:10.55267/iadt.07.14869.

Shokunbi, G. and George, G. 2015. 'Effectiveness of self-instructional information on knowledge of office ergonomics among computer users in educational institutions in North-Eastern Nigeria', Nigerian Journal of Medical Rehabilitation. doi:10.34058/njmr.v18i1.113.

Soltaninejad, M., Pouya, A., Poursadeqiyan, M. and Arefi, M. 2021. 'Ergonomics factors influencing school education during the COVID-19 pandemic: a literature review', Work, 68(1), pp. 69-75. doi:10.3233/wor-203355.

Syarifah, L., Kurniatun, T. and Permana, J. 2019. 'Vocational schools based on regional

potential in Indonesia', Proceedings of the International Conference on Research in Education, Administration & Management (ICREAM). doi:10.2991/icream-18.2019.6.

Tysiąc-Miśta, M., Kruplewicz, M., Grzyb, A., Dziedzic, A. and Tanasiewicz, M. 2024. 'The knowledge and attitude of undergraduate dental students toward dental ergonomic principles in occupational health', Healthcare, 12(16), p. 1566. doi:10.3390/healthcare12161566.

Widiantara, I., Wijayati, N., Lasmini, N., Elfarosa, K. and Suamba, I. 2022. 'Analysis of contextual learning model on ethics and personality development materials for vocational education', Proceedings of the ASEAN Social Science and Humanities Research (ASSEHR). doi:10.2991/assehr.k.220301.073.

Zhao, Y. 2023. 'Research on effective teaching in vocational education from the perspective of school-enterprise cooperation', Region - Educational Research and Reviews, 5(3), p. 202. doi:10.32629/rerr.v5i3.1348.

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