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Development of ergonomic skills of future teachers of preschool organizations based on klax pedagogy

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ABSTRACT

Training future preschool teachers requires the systematic development of ergonomic skills due to the high physical and emotional demands of their professional activity. However, existing teacher education programs often emphasize theoretical knowledge while providing limited opportunities for the development of practical ergonomic competencies. This study addresses this gap by investigating the effectiveness of klax pedagogy, a movement-oriented and experiential approach, in developing ergonomic competence among future preschool teachers. A quasi-experimental pre-test/post-test control group design was employed with 84 students (experimental group: n=42; control group: n=42). The experimental group participated in klax-based activities focused on posture control, movement coordination, spatial organization, and ergonomic awareness, while the control group received traditional instruction. The results revealed a statistically significant improvement in ergonomic skills in the experimental group ($t=9.84$, $p<0.001$; Cohen's $d=1.42$), with the most substantial gains observed in postural ergonomics and spatial organization. In contrast, the control group demonstrated only minor changes. The findings indicate that klax pedagogy is an effective approach for developing ergonomic competence and promoting health-oriented professional behavior. The study contributes to educational ergonomics by providing empirical evidence supporting the integration of movement-based pedagogical approaches into teacher education.

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1. INTRODUCTION

The professional activity of preschool teachers is associated with high physical, emotional, and cognitive demands. Working with young children requires constant movement, prolonged standing, frequent changes in posture, and sustained attention, which often result in fatigue, musculoskeletal strain, and reduced professional efficiency [1], [2]. These conditions highlight the importance of developing ergonomic skills during teacher education to ensure both effective professional performance and long-term occupational health. Ergonomic competence enables future teachers to organize learning environments effectively, maintain proper posture, and use body movements efficiently, thereby reducing health risks associated with

professional activity. Despite its recognized importance, ergonomics is not yet systematically integrated into many teachers' education programs, particularly in preschool training [3], [4]. As a result, graduates often enter professional practice without sufficient preparation for the physical demands of their work.

Previous studies have shown that the physical design of learning environments plays a significant role in comfort and performance. Mismatches between classroom furniture and anthropometric characteristics can lead to poor posture and reduced concentration [5]. In preschool settings, learning environments often do not adequately support children's movement and interaction, which may negatively affect their development and well-being [6], [7]. While existing research has primarily focused on environmental and material aspects of ergonomics, comparatively less attention has been paid to the ergonomic competence of teachers responsible for organizing these environments.

Movement-oriented and embodied learning approaches provide a strong theoretical foundation for addressing this issue. Embodied cognition theory suggests that learning is closely linked to bodily experience and interaction with the environment [8], [9]. Similarly, experiential learning emphasizes active engagement and reflection as key mechanisms for developing professional competencies [10]. These perspectives indicate that ergonomic skills cannot be effectively developed through theoretical instruction alone but require practice, movement, and direct experience. Therefore, there is a need for pedagogical approaches that integrate movement and practical engagement into teacher training.

In this context, klax pedagogy can be considered a movement-oriented and practice-based educational approach that promotes motor coordination, spatial awareness, and embodied professional skills through active engagement and hands-on activities [11], [12]. Although klax pedagogy has been widely applied in early childhood education and recognized as an innovative approach in European contexts [13], [14], its application in the professional training of future preschool teachers remains insufficiently explored. In particular, there is a lack of empirical research examining its effectiveness in developing ergonomic skills among future teachers. This study contributes to the existing literature by providing empirical evidence on the role of klax pedagogy in developing ergonomic competence among future preschool teachers.

The study aimed to evaluate the effectiveness of klax pedagogy in developing ergonomic competence among future preschool teachers compared to traditional instruction. Specifically, it examined overall improvements in ergonomic skills, identified the components demonstrating the greatest gains, and compared outcomes between the experimental and control groups. The novelty of this study lies in its empirical examination of klax pedagogy as a movement-based approach for developing teachers' own ergonomic competence. Unlike previous research, which has primarily focused on classroom environments or health-related risks, this study shifts the focus to the development of ergonomic competence within teacher education. It was hypothesized that the implementation of klax pedagogy would lead to significantly higher levels of ergonomic competence compared to traditional instructional methods.

2. METHOD

This study was conducted using a quasi-experimental pre-test/post-test control group design to evaluate the effectiveness of klax pedagogy in developing ergonomic skills among future preschool teachers. Such designs are commonly applied in educational research when interventions are implemented in real learning environments where full randomization is not possible [15], [16]. The research was carried out over one academic semester (14 weeks) at Abai Kazakh National Pedagogical University, Kazakhstan.

A total of 84 undergraduate students enrolled in a preschool education program participated in the study. They were divided into two groups: an experimental group (n=42) and a control group (n=42). The participants were selected using a purposive sampling approach, as they represented the available cohort of second- and third-year students who had already completed basic pedagogical coursework and were therefore considered appropriate for assessing the development of professional ergonomic skills within teacher education. This approach is considered appropriate in educational research when the aim is to assess competence within a specific training context [17], [18]. Participation was voluntary, and all students provided informed consent prior to the study.

The study was carried out in several stages. First, both groups completed a pre-test to determine their initial level of ergonomic competence. After that, the experimental group took part in a structured intervention based on klax pedagogy, while the control group continued their regular lecture-based training without any targeted ergonomic component. The klax-based intervention included a set of practical and movement-oriented activities. In particular, modular construction tasks were used to develop students' ability to organize space and create ergonomically appropriate learning environments. Balance and posture-focused exercises helped students become more aware of body positioning and improve postural control during professional tasks. In addition, collaborative maker-projects were introduced to support the development of motor coordination, spatial interaction, and teamwork skills through active, hands-on participation. These

activities were integrated into the training process and gradually became more complex over the course of the semester. Finally, a post-test was conducted to assess changes in ergonomic competence after the intervention.

Ergonomic skills were assessed using the ergonomic skills diagnostic scale (ESDS), which was adapted from existing approaches to evaluating ergonomic awareness and behavior in educational contexts [19], [20]. The instrument consisted of four components measured on a five-point Likert scale: spatial organization of the learning environment, health-preserving professional behavior, postural ergonomics, and motor self-regulation. Likert-type scales are widely used in educational research to measure attitudes, perceptions, and levels of agreement [16]. Before data collection, the instrument was reviewed by two experts in ergonomics and education to ensure its clarity and relevance. The reliability of the scale was confirmed with a Cronbach's alpha coefficient of 0.87, indicating high internal consistency.

Data were collected during the academic semester under standardized conditions. All responses were recorded and prepared for statistical analysis. The analysis included both descriptive and inferential statistical methods. The assumptions of normality and homogeneity of variance were tested prior to the analysis and were found to be satisfied. Descriptive statistics (means and standard deviations) were used to summarize the levels of ergonomic competence. To evaluate the effectiveness of the intervention, a paired sample t-test was applied to assess changes within the experimental group, and an independent sample t-test was used to compare post-test results between the experimental and control groups. In addition, effect size was calculated using Cohen's d [21] to determine the magnitude of the observed differences. The level of statistical significance was set at $p<0.05$. The distribution of ergonomic skill levels, mean scores, and changes across different components of ergonomic competence are presented in Tables 1–5.

3. RESULTS AND DISCUSSION

3.1. Baseline equivalence of groups

The baseline levels of ergonomic competence in the experimental and control groups are presented in Table 1. In the experimental group, 45.2% of students demonstrated a low level of ergonomic skills, 40.5% a medium level, and 14.3% a high level. A similar distribution was observed in the control group, where 47.6% of students were at the low level, 38.1% at the medium level, and 14.3% at the high level. These results indicate that both groups had comparable levels of ergonomic competence prior to the intervention.

Statistical analysis confirmed that no significant differences were observed between the experimental and control groups at the baseline stage ($p>0.05$). This equivalence suggests that the groups were initially homogeneous in terms of ergonomic competence. Such baseline comparability strengthens the internal validity of the study and allows subsequent changes to be attributed to the pedagogical intervention rather than pre-existing differences [22].

Table 1. Initial ergonomic skills level

Level	EG (n=42) (%)	CG (n=42) (%)
Low	45.2	47.6
Medium	40.5	38.1
High	14.3	14.3

3.2. Effect of klax pedagogy on ergonomic skills development

The results of the post-test assessment in Table 2, indicate notable differences between the experimental and control groups following the implementation of klax pedagogy. As shown in Table 2, the proportion of students in the experimental group demonstrating a high level of ergonomic competence increased substantially from 14.3% to 52.4%, while the percentage of students at the low level decreased from 45.2% to 9.5%. In contrast, the control group exhibited only minor changes, with most students remaining within the low and medium levels. These results indicate that participation in klax-based activities was associated with a marked improvement in ergonomic competence compared to traditional instruction. The analysis of mean scores in Table 3, further supports these findings.

Table 2. Ergonomic skills level after experiment

Level	EG (n=42) (%)	CG (n=42) (%)
Low	9.5	40.5
Medium	38.1	42.9
High	52.4	16.6

Table 3. Mean ergonomic skill scores

Group	Pre-test (M±SD)	Post-test (M±SD)
EG	2.68±0.41	4.12±0.36
CG	2.71±0.39	2.89±0.42

The experimental group improved from 2.68±0.41 (pre-test) to 4.12±0.36 (post-test), whereas the control group showed only a slight increase from 2.71±0.39 to 2.89±0.42. These results indicate a substantially greater improvement in ergonomic competence among students exposed to klax pedagogy. This difference suggests that movement-based training provides more effective conditions for the development of applied ergonomic skills.

As summarized in Table 4, statistical testing confirmed that the observed changes in the experimental group were significant ($t(41)=9.84$, $p<0.001$), and that the post-test differences between the groups were also statistically significant ($t(82)=6.73$, $p<0.001$). The calculated effect size was large (Cohen's $d=1.42$), indicating a substantial impact of the intervention. These findings provide strong empirical support for the effectiveness of klax pedagogy in developing ergonomic competence.

Table 4. Summary of statistical analysis results

Paired t-test (EG)	Independent t-test (post-test)	Effect size (Cohen's d)
$t=9.84$, $p<0.001$	$t=6.73$, $p<0.001$	$d=1.42$ (large effect)

3.3. Development of ergonomic competence components

A more detailed analysis of the components of ergonomic competence is presented in Table 5. All components showed positive changes after the implementation of klax pedagogy, although the extent of improvement varied across them. The most noticeable gains were observed in postural ergonomics ($\Delta=+1.64$) and spatial organization of the learning environment ($\Delta=+1.45$). Motor self-regulation ($\Delta=+1.39$) and health-preserving professional behavior ($\Delta=+1.29$) also improved, but to a slightly lesser degree.

The stronger progress in posture and spatial organization can be explained by the nature of klax-based activities, which involve active movement, body awareness, and interaction with space. Through repeated practice, students not only understood ergonomic principles but also began to apply them in a more natural and consistent way. This suggests that learning through movement may support deeper internalization of ergonomic skills.

These observations are consistent with earlier studies showing that ergonomic competence develops more effectively through direct interaction with the physical environment rather than through theoretical instruction alone [23]–[25]. In addition, previous research highlights that teachers are frequently exposed to ergonomic risks such as awkward postures and repetitive movements [26]–[29]. From this perspective, the improvements observed in this study can be linked to the practical and experience-based nature of the intervention.

Table 5. Growth by ergonomic components

Component	Pre-test	Post-test	Δ
Postural ergonomics	2.61	4.25	+1.64
Spatial organization	2.73	4.18	+1.45
Motor self-regulation	2.66	4.05	+1.39
Health-preserving behavior	2.72	4.01	+1.29

3.4. Discussion of findings

The findings of this study indicate that klax pedagogy is associated with greater improvements in ergonomic competence among future preschool teachers. These findings are reflected in the significant improvement observed in the experimental group. They suggest that the movement-based and experiential nature of klax pedagogy creates more effective conditions for developing applied ergonomic skills. Unlike traditional lecture-based instruction, this approach allows students not only to understand ergonomic principles but also to apply them in practice. This, in turn, enhances their professional readiness.

These results are consistent with previous research showing that teachers are exposed to considerable ergonomic risks. These risks include musculoskeletal disorders caused by prolonged standing, repetitive movements, and awkward postures [26]–[30]. From this perspective, integrating ergonomics into teacher education is not only relevant but necessary. It can be considered a preventive and competence-based

strategy. Developing ergonomic competence during training may help reduce long-term health risks and improve professional sustainability.

At the same time, the findings suggest that future teachers may have limited familiarity with the principles and practical application of klax pedagogy. This pattern indicates a gap between the potential of innovative pedagogical approaches and their actual use in educational practice. Continuous professional development has been recognized as an essential factor in improving teachers' professional competence and facilitating the adoption of innovative teaching approaches [31]. Similar issues have been reported in the literature. In particular, insufficient pedagogical content knowledge can limit the effective implementation of new teaching methods [32].

From this perspective, continuous professional development and targeted training play an important role in supporting teachers' competencies. They also facilitate the adoption of innovative approaches. The results of this study suggest that klax pedagogy may help bridge the gap between theoretical understanding and practical readiness. It does so by providing opportunities for active, experience-based learning. The limited progress observed in the control group further supports the idea that theoretical instruction alone may not be sufficient for developing ergonomic competence.

In addition, recent studies emphasize the importance of integrating ergonomic principles into educational environments. This helps support teacher well-being and improves the quality of educational practice [33], [34]. Innovative pedagogical approaches are increasingly recognized as important factors in enhancing professional readiness and adaptability in modern education systems [35]. In this context, klax pedagogy appears to be a promising direction for strengthening both professional competence and health-preserving practices in teacher education.

Overall, this study contributes to a deeper understanding of how ergonomic competence is formed within teacher education. It shows that such competence is not limited to theoretical knowledge. Instead, it develops through active practice, reflection, and interaction with real tasks. By integrating cognitive, physical, and spatial dimensions of learning, klax pedagogy creates conditions for forming more stable and transferable professional skills.

These findings also have important implications for educational practice and policy. Integrating movement-based ergonomic training into pre-service teacher education programs may enhance professional readiness. It may also reduce the risk of work-related physical strain. In addition, including ergonomics-focused modules in teacher education curricula can support the development of long-term health-preserving behaviors among future educators.

4. CONCLUSION

This study was aimed at exploring whether klax pedagogy can support the development of ergonomic skills among future preschool teachers. The results show that students engaged in klax-based activities demonstrated higher levels of ergonomic competence compared to those trained through traditional approaches. The most noticeable improvements were observed in posture, spatial organization, and the conscious use of body movements, which are essential for effective and sustainable professional practice.

These findings highlight the value of movement-oriented and practice-based learning in teacher education. Although theoretical knowledge remains important, it appears insufficient on its own for developing applied ergonomic skills. In contrast, klax pedagogy creates conditions in which students can actively apply and internalize ergonomic principles, contributing to the formation of stable professional habits and health-preserving behaviors.

At the same time, the study shows that future teachers are not always sufficiently familiar with the principles of klax pedagogy, which may limit its effective implementation in practice. This indicates the need for broader integration of such approaches into teacher training programs. Overall, the study contributes to the growing body of research on innovative pedagogical approaches by demonstrating that klax pedagogy can serve not only as a tool for child development but also as an important component of professional teacher training. Further research involving larger samples and longitudinal designs would help to better understand how sustainable these effects are and how widely this approach can be applied in teacher education.

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AUTHOR CONTRIBUTIONS STATEMENT

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Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Feruza Abdrimova	✓	✓	✓		✓	✓			✓					
Sholpan Kolumbayeva	✓			✓		✓		✓		✓		✓	✓	
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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

INFORMED CONSENT

We have obtained informed consent from all participants involved in this study.

ETHICAL APPROVAL

The study involving human participants was conducted in accordance with ethical research principles, including anonymity, confidentiality, and voluntary participation, and in line with the principles of the Declaration of Helsinki.

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author, [FA], upon reasonable request.

REFERENCES

[1] M. K. Gouvali and K. Boudolos, "Match between school furniture dimensions and children's anthropometry," *Applied Ergonomics*, vol. 37, no. 6, pp. 765–773, Nov. 2006, doi: 10.1016/j.apergo.2005.11.009.

[2] I. Dianat, M. A. Karimi, A. Asl Hashemi, and S. Bahrampour, "Classroom furniture and anthropometric characteristics of Iranian high school students: Proposed dimensions based on anthropometric data," *Applied Ergonomics*, vol. 44, no. 1, pp. 101–108, Jan. 2013, doi: 10.1016/j.apergo.2012.05.004.

[3] G. Panagiotopoulou, K. Christoulas, A. Papanckolaou, and K. Mandroukas, "Classroom furniture dimensions and anthropometric measures in primary school," *Applied Ergonomics*, vol. 35, no. 2, pp. 121–128, Mar. 2004, doi: 10.1016/j.apergo.2003.11.002.

[4] C. Harris and L. Straker, "Survey of physical ergonomics issues associated with school childrens' use of laptop computers," *International Journal of Industrial Ergonomics*, vol. 34, no. 1, pp. 1–9, 2004, doi: 10.1016/S0169-8141(00)00009-3.

[5] B. Iliev, D. Domljan, and Z. Vlaović, "Comparison of anthropometric dimensions of preschool children and chairs in kindergartens in North Macedonia, Bulgaria and Croatia," *Heliyon*, vol. 9, no. 3, p. e14483, Mar. 2023, doi: 10.1016/j.heliyon.2023.e14483.

[6] S. A. Oyewole, J. M. Haight, and A. Freivalds, "The ergonomic design of classroom furniture/computer work station for first graders in the elementary school," *International Journal of Industrial Ergonomics*, vol. 40, no. 4, pp. 437–447, Jul. 2010, doi: 10.1016/j.ergon.2010.02.002.

[7] L. O. Magnusson and A. Elm, "The Entangled Intersection of Children's and Educators' Engagement in the Educational Environment of a Preschool," *Early Childhood Education Journal*, vol. 52, no. 8, pp. 1923–1932, Dec. 2024, doi: 10.1007/s10643-023-01533-4.

[8] M. Wilson, "Six views of embodied cognition," *Psychonomic Bulletin and Review*, vol. 9, no. 4, pp. 625–636, Dec. 2002, doi: 10.3758/BF03196322.

[9] L. A. Shapiro, *Embodied cognition*, 2nd ed. New York, NY: Routledge, 2019.

[10] D. A. Kolb, *Experiential Learning: Experience as the Source of Learning and Development*, 2nd ed. Upper Saddle River, NJ: Pearson FT Press, 2015.

[11] C. Kontra, S. Goldin-Meadow, and S. L. Beilock, "Embodied Learning Across the Life Span," *Topics in Cognitive Science*, vol. 4, no. 4, pp. 731–739, Oct. 2012, doi: 10.1111/j.1756-8765.2012.01221.x.

[12] F. Abdrimova, "Preparation for innovative activity of teachers of preschool organizations on the basis of klax pedagogy," *BULLETIN Series of Pedagogical Sciences*, vol. 80, no. 4(2023), 2024, doi: 10.51889/2959-5762.2023.80.4.018.

[13] M. Hnatiuk, "The role of comparative pedagogy in evaluating education systems of different countries," *Comparative Professional Pedagogy*, vol. 7, no. 3, pp. 93–98, Sep. 2017, doi: 10.1515/rpp-2017-0041.

[14] H. Knauf, *Pedagogical Documentation in Early Childhood Education*. Wiesbaden: Springer Fachmedien Wiesbaden, 2022, doi: 10.1007/978-3-658-39736-4.

[15] J. W. Creswell, *Research design: qualitative, quantitative, and mixed methods approaches*, 4th ed. Thousand Oaks, CA: SAGE Publications, Inc., 2014.

[16] L. Cohen, L. Manion, and K. Morrison, *Research Methods in Education*. London: Routledge, 2017, doi: 10.4324/9781315456539.
[17] A. S. Cifter, I. Eroglu, and K. Ozcan, "A Study of Ergonomics Education in Industrial Design Programs in Turkey," *International Journal of Mechanical Engineering Education*, vol. 41, no. 4, pp. 306–314, Oct. 2013, doi: 10.7227/IJMEE.41.4.5.
[18] H. Taherdoost, "Sampling methods in research methodology: How to choose a sampling technique for research," *International Journal of Academic Research in Management (IJARM)*, vol. 5, no. 2, pp. 18–27, 2016.
[19] E. Kahya, "Mismatch between classroom furniture and anthropometric measures of university students," *International Journal of Industrial Ergonomics*, vol. 74, p. 102864, Nov. 2019, doi: 10.1016/j.ergon.2019.102864.
[20] R. Jaafar, A. Akmal, and Z. Libasin, "Ergonomics knowledge among engineering students in Pulau Pinang Malaysia," *Journal of Modern Manufacturing Systems and Technology*, vol. 5, no. 2, pp. 9–14, Aug. 2021, doi: 10.15282/jmmst.v5i2.6658.
[21] J. Cohen, *Statistical Power Analysis for the Behavioral Sciences*, 2nd ed. Hillsdale: Lawrence Erlbaum Associates, 1988.
[22] J. W. Creswell and V. L. P. Clark, *Designing and Conducting Mixed Methods Research*. Thousand Oaks: SAGE, 2011.
[23] S. Legg and K. Jacobs, "Ergonomics for schools," *Work*, vol. 31, no. 4, pp. 489–493, Dec. 2008, doi: 10.3233/wor-2008-00834.
[24] H. Y. K. Cheng, M. T. Wong, Y. C. Yu, and Y. Y. Ju, "Work-related musculoskeletal disorders and ergonomic risk factors in special education teachers and teacher's aides," *BMC Public Health*, vol. 16, no. 1, p. 137, Dec. 2016, doi: 10.1186/s12889-016-2777-7.
[25] K. Kraemer, M. F. Moreira, and B. Guimarães, "Musculoskeletal pain and ergonomic risks in teachers of a federal institution," *Revista Brasileira de Medicina do Trabalho*, vol. 18, no. 3, pp. 343–351, 2021, doi: 10.47626/1679-4435-2020-608.
[26] P. N. Erick and D. R. Smith, "A systematic review of musculoskeletal disorders among school teachers," *BMC Musculoskeletal Disorders*, vol. 12, no. 1, p. 260, Dec. 2011, doi: 10.1186/1471-2474-12-260.
[27] D. Converso, S. Viotti, I. Sottimano, V. Cascio, and G. Guidetti, "Musculoskeletal disorders among preschool teachers: analyzing the relationships among relational demands, work meaning, and intention to leave the job," *BMC Musculoskeletal Disorders*, vol. 19, no. 1, p. 156, Dec. 2018, doi: 10.1186/s12891-018-2081-z.
[28] S. Tahernejad, A. Hejazi, E. Rezaei, F. Makki, A. Sahebi, and Z. Zangiabadi, "Musculoskeletal disorders among teachers: a systematic review and meta-analysis," *Frontiers in Public Health*, vol. 12, p. 1399552, Oct. 2024, doi: 10.3389/fpubh.2024.1399552.
[29] A. A. A. Rahim, M. S. Jeffree, D. M. A. Daud, N. Pang, and M. F. Sazali, "Factors associated with musculoskeletal disorders among regular and special education teachers: a narrative review," *International Journal of Environmental Research and Public Health*, vol. 19, no. 18, p. 11704, Sep. 2022, doi: 10.3390/ijerph191811704.
[30] A. Lundberg, C. Lindh, and P. Collberg, "Are newly qualified preschool teachers ready for today's mandate? Principals' views in Sweden," *Journal of Early Childhood Teacher Education*, vol. 45, no. 3, pp. 352–370, Jul. 2024, doi: 10.1080/10901027.2024.2349050.
[31] B. Bahriadi, A. Suriansyah, and S. Sulaiman, "Continuous professional development model to improve teacher professional competence," *International Journal of Social Science and Human Research*, vol. 05, no. 12, Dec. 2022, doi: 10.47191/ijsshr/v5-i12-89.
[32] P. Ward and I. Kim, "Unpacking pedagogical content knowledge in physical education: what we know and do not know," *Kinesiology Review*, vol. 13, no. 2, pp. 176–185, May 2024, doi: 10.1123/kr.2023-0076.
[33] A. V. Ablyaeva, A. I. Minacheva, and L. M. Fatkhutdinova, "Influence of ergonomics of schoolchildren's workplaces on the occurrence of musculoskeletal discomfort," *Gigiena i Sanitariya*, vol. 101, no. 12, pp. 1548–1554, 2022, doi: 10.47470/0016-9900-2022-101-12-1548-1554.
[34] G. K. Dlimbetov, K. I. Zhumazhanova, M. A. Buribayeva, and S. K. Moldabekova, "Training future educators: the significance of ergonomic approaches in crafting safe educational spaces in Kazakhstan," *European Journal of Contemporary Education*, vol. 13, no. 1, 2024, doi: 10.13187/ejced.2024.1.36.
[35] D. Murphy, "Caring about early childhood education," in *Early Childhood Education - Innovative Pedagogical Approaches in the Post-modern Era*, IntechOpen, 2023, doi: 10.5772/intechopen.104674.

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