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Assessment of Students' Safety and Environmental Activities for Teaching Milling Machine Maintenance in Technical Colleges

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Abstract

The increasing complexity of industrial machinery necessitates a standardized approach to safety and maintenance training within technical education. Objective: This study aimed to assess students' activities regarding safety measures for inclusion in a capacity-building module designed for teaching milling machine maintenance in technical colleges. Methodology: A descriptive survey research design was adopted, gathering data from technical educators and workshop instructors in Delta State. The sample comprised 70 respondents, including 26 technical teachers and 44 workshop instructors, drawn from four government technical colleges. Data collection was facilitated through structured questionnaires, while mean, standard deviation, and t-test statistics were employed for comprehensive data analysis. Findings: The results revealed that both technical teachers and workshop instructors strongly agreed that the identified safety measures, instructional materials, and methodologies were highly appropriate for inclusion in the developed module. Furthermore, no significant differences were found in the responses of the two groups, underscoring a professional consensus on the variables required to enhance effective teaching and safe practices. Conclusion & Recommendations: The study concludes that the developed capacity-building module serves as a critical tool for improving teaching and learning outcomes in milling machine maintenance. It is recommended that technical teachers strictly adopt these safety measures in their instructional activities. Additionally, curriculum planners and the National Board for Technical Education (NBTE) should integrate the module into formal programs, supported by government and administrative resources to ensure successful implementation.

Keywords: Safety measures, instructional materials, methodologies, capacity building module, milling machine maintenance.

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Introduction

Technical education plays a pivotal role in equipping learners with practical skills, technical knowledge, and professional attitudes required for industrial productivity and technological development. Within this context, the teaching of mechanical engineering craft practice, particularly milling machine maintenance, is crucial in ensuring that students acquire the competence needed for industrial operations. A capacity building module becomes an effective tool for enhancing teaching and learning outcomes in technical colleges when it adequately integrates students' activities, appropriate instructional methodologies, relevant instructional materials, and safety measures that prepare learners for workplace realities. The place of students' activities in a capacity building module cannot be underestimated. According to (Kerimbayev et al., 2023), meaningful student involvement enhances mastery of skills, promotes creativity, and develops competence in handling machines such as milling machines. Students' activities in module development include guided practice, hands-on participation, and engagement with technical tasks that improve both cognitive and psychomotor domains. The integration of students' activities therefore ensures active learning, retention, and skill transfer from classroom to industrial settings.

Equally important is the role of instructional materials in technical education. Instructional materials serve as mediators between teachers and learners in achieving desired outcomes. As (Hadiyanto, 2024) emphasized, adequate instructional support ensures that learners not only understand the concepts but also apply them in real-life contexts. Properly selected and utilized instructional materials, ranging from diagrams, manuals, and models to actual machine parts, facilitate better understanding of safety measures and machine operations. Without adequate instructional materials, learning becomes abstract, thereby limiting students' competence in milling machine maintenance. The methodology adopted in teaching technical subjects is another vital component of effective learning. (Bhardwaj et al., 2025) highlighted the need for student-centered methodologies such as demonstration, guided practice, and problem-solving approaches in teaching machine maintenance. Methodologies that encourage active participation, immediate feedback, and practical engagement foster not only technical competence but also safety consciousness in machine operation. The choice of methodology in a capacity building module therefore directly impacts how well students internalize safety procedures and operational standards in milling machine maintenance.

Safety remains central in machine operation and maintenance. As (Andersen et al., 2025) noted, safety is the condition of being free from risks, hazards, and injuries, while Ngara, (Phelps et al., 2024) emphasized that safety in schools ensures that both teachers and students are not exposed to danger or aggression. In the teaching of milling machine maintenance, students must be trained to observe safety measures such as wearing protective equipment, following operational checks, and understanding potential hazards like rotating parts, sharp edges, vibration, and noise. A safe learning environment guarantees not only protection from harm but also the confidence and motivation to learn effectively. Related empirical studies also reveal the importance of integrating safety and students' activities into instructional modules. Research findings show that when students are actively engaged in safety-conscious activities, they develop higher competence in

both operational and preventive maintenance of machines (Grannäs et al., 2025). However, despite the recognition of these factors, gaps still exist in technical colleges in Delta State, where students' activities, instructional materials, and effective methodologies are not adequately assessed for inclusion in capacity building modules. This gap limits the preparedness of technical college graduates for the demands of modern industries.

Therefore, it becomes necessary to assess students' activities on safety measures for inclusion in a capacity building module for teaching milling machine maintenance in technical colleges. This study will provide empirical evidence on how students' activities, instructional materials, and methodologies can be systematically integrated to improve teaching outcomes and safety compliance. Hence, this study focuses on the assessment of students' activities on safety measures for inclusion in a capacity building module for teaching milling machine maintenance in technical colleges (Tandika & Ndijuye, 2022). The maintenance of milling machines in technical colleges requires strict adherence to safety measures to prevent accidents, injuries, and machine breakdowns. Despite the availability of guidelines and established practices, students in technical colleges often lack adequate exposure to environmental safety-oriented activities that ensure competence in handling and maintaining machines. Previous research and module developments have addressed aspects of safety and student engagement in technical education (Ghanbaripour et al., 2024). However, there remains a gap in the systematic assessment of students' activities, instructional materials, and methodologies specifically designed for inclusion in a capacity building module for teaching milling machine maintenance (Li & Rohayati, 2024). This inadequacy contributes to persistent challenges such as accidents, poor competence levels, and limited preparedness of graduates for industrial demands (Kholifah et al., 2025).

This study is motivated by the urgent need to bridge this gap by examining how students' activities, instructional materials, and teaching methodologies can be better assessed and integrated into a module. The question that arises therefore is: How can students' activities on safety and environmental measures be assessed and included in a capacity building module for teaching milling machine maintenance in technical colleges?.The main aim of this study is to assess students' activities on safety and environmental measures for inclusion in a capacity building module for teaching milling machine maintenance in technical colleges. The objectives of the study are to: Assess students' activities on safety and environmental measures for inclusion in a capacity building module for teaching milling machine maintenance; There is no significant difference in the mean responses of technical teachers and workshop instructors regarding the instructional materials needed for the evaluation of students' activities with respect to the modules of safety and environmental considerations to be included in the modules (Li & Rohayati, 2024); There is no significant difference in the mean responses of technical teachers and workshop instructors regarding the methods appropriate to evaluate students' activities concerning the modules of safety and environmental considerations to be included in the modules.

The following research questions guide the study: What are the students' activities on safety and environmental measures that should be included in a capacity building module for teaching milling machine maintenance?; What are the instructional materials required for assessing students' activities on safety and environmental measures for inclusion in the module?; What are the methodologies suitable for assessing students' activities on safety and environmental measures for inclusion in the module?. The following null hypotheses will be tested at 0.05 level of significance: There is no significant difference between the mean responses of technical teachers and workshop instructors on the students' activities on safety and environmental measures for inclusion in a capacity building module for teaching milling machine maintenance; There is no significant difference between the mean responses of technical teachers and workshop instructors on the instructional materials required for assessing students' activities on safety and environmental measures for inclusion in the module; There is no significant difference between

the mean responses of technical teachers and workshop instructors regarding the methodologies suitable for assessing students' activities on safety and environmental measures for inclusion in the module.

This study will be of great benefit to students, teachers, curriculum planners, administrators, and the government. Mechanical engineering craft practice students will gain both theoretical and practical knowledge in milling machine maintenance, enhancing their efficiency, safety awareness, and self-reliance after graduation. Technical teachers and workshop instructors will benefit from improved instructional delivery, the use of appropriate instructional materials, and practical guidance for effective teaching and machine repair. The National Board of Technical Education (NBTE) and curriculum planners will also find the study useful in enriching existing curricula with detailed coverage of maintenance and environmental safety measures. Furthermore, school administrators and government agencies will benefit through reduced repair and replacement costs, since the developed module emphasizes preventive maintenance and safety compliance. The study is limited to construction of a capacity building module for the teaching of milling machine maintenance in mechanical engineering craft practice in technical colleges located in Delta State. The study examined specific components such as the objectives, content, students' activities, instructional materials, teaching methods, evaluation, safety, and the geographical scope was limited to six technical colleges in Delta State: Government Technical College, Agbor; Government Technical College, Sapele; Government Technical College, Kwale; Government Technical College, Ofagbe; Government Technical College, Oto-gor; and Government Technical College, Issele-Uku.

Methodology

This chapter outlines the methods and techniques used in the study, covering the research design and framework, study area, population, sampling, instrument(s) and procedures of data collection, and the methods (analytical and descriptive) utilized in the research. The study adopted the Research and Development (R & D) design, considered most suitable for educational research that seeks to design, validate, and refine instructional materials. According to Bayarçelik and Taşel (2013), R & D design applies research findings in the creation of products and procedures, which are then tested and improved until they meet required standards. Lomas (2017) also emphasized that R & D involves systematic and creative work to increase knowledge and apply it to practical products of social and educational value.

This design was adopted because the present study aimed at developing a module for teaching milling machine maintenance in Mechanical Engineering Craft Practice in technical colleges. The process was guided by the R & D steps of Gall and Borg (2007), as cited in Ordu (2020) and Ojukwu (2021), but modified to suit the study objectives. The ten steps were condensed into five broad phases:

- Phase I: Collection of baseline data on objectives, content, teacher and student activities, teaching/learning materials, methodologies, and evaluation procedures relevant to the module.
- Phase II: Development of the draft maintenance module incorporating the above elements.
- Phase III: Validation of the draft module by three subject-matter experts.
- Phase IV: Assessment of the developed module in actual classroom/workshop contexts to determine its suitability.
- Phase V: Revision of the module based on feedback from validation and assessment.

This study was conducted in Delta State, Nigeria, with Asaba as its capital. Delta State covers 17,108 km² with over 6 million residents (National Population Census, 2019) and is one of the oil-producing states in the South-South geopolitical zone. Delta State was selected because of

the presence of functional Government Technical Colleges with classrooms for Mechanical Engineering Craft Practice, particularly at Agbor, Asaba, Effurun, and Obiaruku. These schools offered an enriched environment for the formulation and implementation of the maintenance module. The study population consisted of 68 technical education staff members (28 technical teachers and 40 workshop instructors) from six Government Technical Colleges in Delta State. This population was deemed appropriate because they directly engage in teaching, monitoring and evaluating maintenance practices of the milling machines. study sample comprised 70 respondents (26 technical teachers and 44 workshop instructors) from four Government Technical Colleges in Delta State. Given the limited number of staff, the study adopted a census approach on the entire available population. This strategy is in line with the suggestion by Singh and Masuku (2014) to use a census when the population is small and manageable. To guarantee validity, the instrument was subjected to face and content validation by three experts: two from the Department of Technical Education, Ignatius Ajuru University of Education, Port Harcourt, and one from Government Technical College, Agbor. Their feedback helped to improve the construction of the items of the questionnaires and also to align them with the purpose of the study.

To establish the reliability of the instrument, a trial test was conducted with 30 respondents (20 teachers and 10 instructors) from Government Technical College, Ahoada, Rivers State, who were outside the study area. Reliability coefficients were calculated using the Cronbach Alpha method, with a range of 0.84 to 0.89, and an overall reliability of 0.87. This was found to meet Ajoku's (in Ordu, 2020) criteria that a coefficient of 0.50 and above is deemed acceptable. This was computed using SPSS version 22. The main instrument was a structured questionnaire prepared by the researcher, and is titled Module for Teaching Maintenance of Milling Machine in Mechanical Engineering Craft Practice (MTMMMMECP). It was structured into seven sections (A–G) each of which addresses the critical aspects of the module: objectives, content, teachers' activities, students' activities, teaching/learning materials, methodologies and evaluation. Respondents' contributions were assessed using a 5-point Likert scale, with the options of Highly Appropriate (5) and Highly Inappropriate (1). The responses from the questionnaires were processed through the parameters of the mean and standard deviation in order to respond to the research questions. A mean of 3.50 was determined as the threshold; mean scores of 3.50 and above were deemed "appropriate," mean scores below 3.50 were deemed "inappropriate." The standard deviation was used to evaluate the responses' level of agreement. In addition, the t-test was utilized to evaluate the hypotheses in the 0.05 level of significance. The null hypothesis was accepted when the calculated t-value was lower than 0.05; otherwise, the null was rejected. All of the analyses were computed using the SPSS version 23.

Results

Data collected in the study were presented and analyzed in the following tables.

Research Question 1

What are the students' activities on safety and environmental measures that should be included in a capacity building module for teaching milling machine maintenance?

Results in Table 1 showed mean ratings ranging from 3.86 to 4.20 for technical teachers and 3.68 to 4.28 for workshop instructors, with grand means of 4.03 and 4.02 respectively. These findings indicate that both groups agreed that the identified safety-related students' activities are appropriate for inclusion in the developed capacity building module. The closeness of the standard deviations demonstrates homogeneity in their responses.

Table 1. Mean and standard deviation of responses on students' safety activities for inclusion in the capacity building module for teaching milling machine maintenance in technical colleges in delta state

	Safety Measures	Technical Teachers N =28			Workshop Instructors N = 40		
S/No	Students' Activities	X	SD	Remark	X	SD	Remark
1.	Define safety measure	4.18	.97	Appropriate	4.28	.74	Appropriate
2.	Take note on the reasons for observing safety measures	3.86	.87	Appropriate	3.92	.91	Appropriate
3.	Identify the sources of hazards in workshop	4.05	.94	Appropriate	4.28	.79	Appropriate
4.	Records the ways to prevent them	4.05	1.01	Appropriate	3.92	.64	Appropriate
5.	Ask and answer question pertaining the application of factory safety regulations in machine shop	4.20	.98	Appropriate	4.04	.98	Appropriate
1.	Take records of the organizational structure to manage risk	4.09	.71	Appropriate	4.12	.88	Appropriate
7.	Identify workplace risk and implement suitable control	3.95	.99	Appropriate	4.08	1.00	Appropriate
8.	Take record of the safety equipment and wears	4.02	.79	Appropriate	4.28	.79	Appropriate
9.	Ask and answer question on their application in working situations.	3.93	1.09	Appropriate	3.84	.94	Appropriate
10.	Take note thesafety rules and regulations.	3.95	1.16	Appropriate	3.68	.99	Appropriate
11.	Give key attention on the teacher/instructor explanation on appropriate procedures in the events of a workshop accident	3.93	.90	Appropriate	3.96	1.09	Appropriate
12.	Record important of first aids in workshop	4.00	1.03	Appropriate	4.20	.82	Appropriate
13.	Mention items contained in first aids box	4.14	.93	Appropriate	3.72	.94	Appropriate
	Grand Mean/SD	4.03	.95	Appropriate	4.02	.89	Appropriate

Source: Researcher's Field Survey (2023)

Research question 2: What are the instructional materials required for assessing students' activities on safety and environmental measures for inclusion in the module?

Findings in Table 2 revealed mean scores between 3.98 and 4.20 for technical teachers and between 3.72 and 4.32 for workshop instructors, with grand means of 4.09 and 4.03 respectively. This indicates consensus that the listed instructional materials are appropriate for assessing students' safety activities and should be integrated into the developed module. The small range of standard deviations shows uniformity of responses.

Table 2. Mean and Standard Deviation of Responses on Instructional Materials for Inclusion in the Capacity Building Module for Teaching Milling Machine Maintenance in Technical Colleges in Delta State

		Technical Teachers N =28			Workshop Instructors N = 40		
S/No	Instructional Materials	X	SD	Remark	X	SD	Remark
1	Installed Milling machine	4.02	1.15	Appropriate	3.92	1.00	Appropriate
2	Common hand tools like spanners, ally keys etc.	4.07	1.08	Appropriate	4.24	.93	Appropriate
3	Detectors/sensor monitoring	4.20	.98	Appropriate	4.24	.88	Appropriate
4	Damaged V-belts	4.09	.71	Appropriate	4.12	.83	Appropriate
5	Poster/charts	4.07	.97	Appropriate	3.80	.96	Appropriate
6	Coverall of moderate sizes	4.16	1.14	Appropriate	3.92	1.04	Appropriate
7	Goggles, Gloves, hard shoes	4.14	.98	Appropriate	4.32	.69	Appropriate
8	Fire extinguisher milling machines spare-parts	3.98	.93	Appropriate	4.00	.96	Appropriate
9	All kinds lubricants	4.14	.93	Appropriate	3.72	.98	Appropriate
	Grand Mean/SD	4.09	.99	Appropriate	4.03	.92	Appropriate

Source: Researcher's Field Survey (2023)

Research question 3: What are the methodologies suitable for assessing students' activities on safety and environmental measures for inclusion in the module?

Table 3. Mean and Standard Deviation of Responses on Methodologies for Inclusion in the Capacity Building Module for Teaching Milling Machine Maintenance in Technical Colleges in Delta State

S/No	Teaching Methods	Technical Teachers N =28			Workshop Instructors N = 40		
		X	SD	Remark	X	SD	Remark
1	Activity method	3.91	1.18	Appropriate	4.04	1.02	Appropriate
2	Discussion method	4.14	.96	Appropriate	4.00	.91	Appropriate
3	Question-and-answer method	3.98	.762	Appropriate	3.96	1.2	Appropriate
4	Demonstration method	3.86	.93	Appropriate	4.16	.99	Appropriate
5	Interactive method	4.45	.79	Appropriate	4.24	1.01	Appropriate
6	Project method	4.43	.76	Appropriate	4.00	.91	Appropriate
	Grand Mean/SD	4.13	.90	Appropriate	4.07	1.01	Appropriate

Source: Researcher's Field Survey (2023)

Table 3 shows that technical teachers had mean ratings between 3.86 and 4.45, while workshop instructors had between 3.96 and 4.24, with grand means of 4.13 and 4.07 respectively. Both groups agreed that all the listed teaching methodologies are appropriate for inclusion in the developed capacity building module. The closeness of standard deviations confirms the consistency of their views. Hypothesis 1: There is no significant difference of mean responses of technical teachers and workshop instructors on students' activities pertaining to the inclusion of safety and environmental measures in a capacity building module for teaching milling machine maintenance.

Table 4. t-test Result on Students' Activities Related to Safety and environmental Measures for Inclusion in the Capacity Building Module

Respondents	N	Mean	Std. Deviation	df	p-value	t-cal	t-crit	Remark
Technical Teachers	20	4.14	0.93					
				78	.05	.25	1.67	Accepted
Workshop Instructors	40	4.11	.90					

Source: Researcher's Field Survey (2023)

Table 4 shows a t-calculated value of (.25) which is lower than the t-critical value of (1.67) at 0.05 level of significance. This is the basis for accepting the null hypothesis, which means there is no significant difference in the responses of technical teachers and workshop instructors on students' safety activities to be included in the module.

Hypothesis 2: There is no significant difference between the mean responses of technical teachers and workshop instructors on the teaching materials necessary for evaluating students' activities in relation to safety and environmental measures for inclusion in the module.

Table 5. t-test Result on Instructional Materials for Assessing Students' Safety Activities in the Capacity Building Module

Respondents	N	Mean	Std. Deviation	df	p-value	t-cal	t-crit	Remark
Technical Teachers	20	4.09	.99					
				78	.05	.27	1.67	Accepted
Workshop Instructors	40	4.03	.92					

Source: Researcher's Field Survey (2023)

The accepted value of the t calculated value of (.27) and the t critical value of (1.67) at 0.05 significance level implies that there is no difference in the null hypothesis. This indicates that there is no difference in the mean responses of the technical teachers and the workshop instructors regarding the instructional materials to be included in the modules.

Hypothesis 3: There is no difference in the mean responses of the technical teachers and the workshop instructors regarding the methods appropriate to evaluate students' activities on the safety and environmental aspects for inclusion in the module.

Table 6. t-test Result on Methodologies for Assessing Students' Safety Activities in the Capacity Building Module

Respondents	N	Mean	Std. Deviation	df	p-value	t-cal.	t-crit.	Remark
Technical Teachers	20	4.13	0.90					
				78	0.05	0.39	1.67	Accepted
Workshop Instructors	40	4.07	1.01					

Source: Researcher's Field Survey (2023)

Table 6 showed a t-calculated value (.39) lower than the t-critical value (1.67) at 0.05 level of significance. The null hypothesis was therefore accepted, signifying that both technical teachers and workshop instructors held similar views on methodologies that should be included in the developed capacity building module.

Discussion

The findings of this study revealed that safety and environmental measures constitute an essential component of a capacity building module for teaching maintenance of milling machines in mechanical engineering craft practice in technical colleges in Delta State. Both technical teachers and workshop instructors strongly agreed that the identified safety items should be included, as reflected in their high mean ratings and close standard deviations which indicated homogeneity of responses (Zamiri & Esmaeili, 2024). Furthermore, hypothesis testing showed no significant difference in their views, which underscores a shared understanding of the importance of safety training. This finding aligns with (Savolainen, 2023) who emphasized that training modules should be user-friendly and adaptable, thereby creating safer learning environments. Similarly, (Zahid & Nawab, 2025) noted that teachers are expected to individualize instruction, and embedding safety measures within teacher and student activities ensures a structured approach to meeting learners' diverse needs. In line with (Türközü & Dinçer, 2025), the integration of safety practices into students' activities also ensures that learning objectives are systematically sequenced to promote efficiency and learner confidence (Mohammadi et al., 2025).

In addition, the study established that instructional materials are indispensable for the successful delivery of maintenance training. Respondents affirmed that the listed materials were suitable for inclusion in the module, as demonstrated by high mean values and low variability in responses. The null hypothesis was also retained, suggesting consensus between technical teachers and workshop instructors. This result supports (Garay Abad & Hattie, 2025), who argued that instructional materials enhance teaching effectiveness when tailored to the needs of teachers and learners. It also resonates with (Yang et al., 2024) who emphasized the selection of accurate, engaging, and age-appropriate instructional resources that enrich the curriculum. Therefore, the availability and effective use of relevant instructional materials within the module will not only improve lesson delivery but also make learning more concrete and meaningful.

Furthermore, findings on suitable methodologies revealed that both groups of respondents agreed that all listed teaching methods should be adopted in the developed module. The grand means from both groups were consistently high, while hypothesis testing confirmed no significant difference in their responses. This reflects a shared view that effective teaching strategies are central to module implementation. The findings corroborate (Kaloudis et al., 2025) who maintained that the choice of methodology determines the level of student engagement and learning outcomes. Incorporating diverse instructional methods, rather than relying solely on traditional lectures, provides learners with opportunities for active participation, problem-solving, and practical skill development. By doing so, the module becomes dynamic and responsive to learners' needs, thereby facilitating higher achievement and skill acquisition.

Overall, the discussion of findings demonstrates that safety and environmental measures, instructional materials, and methodologies are all vital components of a robust capacity building module for teaching milling machine maintenance in technical colleges (Morina et al., 2025). The consistency of responses across technical teachers and workshop instructors highlights the practical relevance of the identified components. More importantly, the agreement of these findings with existing literature validates the module design and strengthens its potential to enhance both teaching effectiveness and student learning outcomes in the Delta State context (Nsabayezu et al., 2025).

Conclusion

The findings of this study have shown that safety and environmental measures, instructional materials, and methodologies are indispensable components in the development of a capacity building module for teaching milling machine maintenance in mechanical engineering craft practice in technical colleges in Delta State. Both technical teachers and workshop instructors strongly agreed on the relevance of these components, and hypothesis testing confirmed no significant differences in their responses, underscoring consensus on their importance. This confirms that the developed module has the potential to enhance teaching effectiveness, improve students' practical competence, and promote safe handling and maintenance of milling machines, thereby contributing to quality technical education and skill development. Based on the findings of this study, the following recommendations are made: Technical teachers and workshop instructors should consistently integrate safety and environmental measures into both theoretical and practical sessions when teaching milling machine maintenance, ensuring that students develop a culture of safe handling and preventive practices; Curriculum planners and the National Board for Technical Education (NBTE) should formally adopt and integrate the developed module into technical college curricula, with special emphasis on providing relevant instructional materials and updated methodologies; School administrators and government agencies should provide sustained support through funding, supply of instructional resources, and continuous professional development opportunities for teachers and instructors to effectively implement the developed capacity building module.

Conflicts of Interest

There were no Conflicts of Interest

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Author Contributions

Iteku: Conceptualization, methodology, validation; Johnson Abor: formal analysis, investigation; resources, data curation; Nathan Udoinyang: original draft writing; Reuben Daniel: review and editing, visualization. All authors have read and approved the final manuscript:

Declaration of generative AI in scientific writing

The author(s) employed generative AI tools (specifically Grammarly to refine the linguistic quality and structural organization of this article. All AI-generated suggestions were critically evaluated by the authors, who maintain full accountability for the accuracy and integrity of the final work.

References

Andersen, L. P. S., Aust, B., & Winding, T. N. (2025). Pupils' aggressive behaviour towards teachers: Identifying protective factors at organizational level examined in a follow-up study. *BMC Psychology*, *13*(1), 247. https://doi.org/10.1186/s40359-025-02564-9

Bhardwaj, V., Zhang, S., Tan, Y. Q., & Pandey, V. (2025). Redefining learning: Student-centered strategies for academic and personal growth. *Frontiers in Education*, *10*, 1518602. https://doi.org/10.3389/feduc.2025.1518602

Garay Abad, L., & Hattie, J. (2025). The impact of teaching materials on instructional design and teacher development. *Frontiers in Education*, *10*, 1577721. https://doi.org/10.3389/feduc.2025.1577721

Ghanbaripour, A. N., Talebian, N., Miller, D., Tumpa, R. J., Zhang, W., Golmoradi, M., & Skitmore, M. (2024). A Systematic Review of the Impact of Emerging Technologies on Student Learning, Engagement, and Employability in Built Environment Education. *Buildings*, *14*(9), 2769. https://doi.org/10.3390/buildings14092769

Grannäs, J., Frelin, A., Lorentzi, K., & Bergström, M. L. (2025). Designing and building safer schools using two visual methods for teacher evaluation. *International Journal of Educational Research*, *133*, 102721. https://doi.org/10.1016/j.ijer.2025.102721

Hadiyanto, H. (2024). Application of Student-Centered Learning in Improving Teaching English as a Foreign Language Students' 21st-Century Skills Performance. *Education Sciences*, *14*(9), 938. https://doi.org/10.3390/educsci14090938

Kaloudis, T., Georgiadis, K., Travlos, A. K., & Theodorakis, Y. (2025). Fostering Reflective Thinking in Physical Education Teachers: An Action Research Study Promoting Paralympic Values and Inclusive Practices. *Education Sciences*, *15*(7), 823. https://doi.org/10.3390/educsci15070823

Kerimbayev, N., Umirzakova, Z., Shadiev, R., & Jotsov, V. (2023). A student-centered approach using modern technologies in distance learning: A systematic review of the literature. *Smart Learning Environments*, *10*(1), 61. https://doi.org/10.1186/s40561-023-00280-8

Kholifah, N., Nurtanto, M., Sutrisno, V. L. P., Majid, N. W. A., Subakti, H., Daryono, R. W., & Achmadi, A. (2025). Unlocking workforce readiness through digital employability skills in vocational education Graduates: A PLS-SEM analysis based on human capital Theory. *Social Sciences & Humanities Open*, *11*, 101625. https://doi.org/10.1016/j.ssaho.2025.101625

Li, M., & Rohayati, M. I. (2024). The Relationship between Learning Outcomes and Graduate Competences: The Chain-Mediating Roles of Project-Based Learning and Assessment Strategies. *Sustainability*, *16*(14), 6080. https://doi.org/10.3390/su16146080

Mohammadi, M., Paasivara, M., & Kasurinen, J. (2025). Blended learning in higher education: Good practices in platforms and teachers support, enhancing students motivation. *Education and Information Technologies*, *30*(18), 26001–26024. https://doi.org/10.1007/s10639-025-13770-8

Morina, F., Fütterer, T., Hübner, N., Zitzmann, S., & Fischer, C. (2025). Effects of online teacher professional development on teacher-, classroom-, and student-level outcomes: A meta-analysis. *Computers & Education*, *228*, 105247. https://doi.org/10.1016/j.compedu.2025.105247

Nsabayezu, E., Habimana, O., Nzabalirwa, W., & Niyonzima, F. N. (2025). 6Ps-based instructional model: An innovative framework for supporting organic chemistry education through a multimedia-supported flipped classroom approach. *Discover Education*, *4*(1), 324. https://doi.org/10.1007/s44217-025-00775-1

Phelps, C., Kim, E. K., & Jimerson, S. R. (2024). Promoting Safe and Supportive Schools: Contemporary Research Advancing Science, Practice, and Policy. *School Psychology Review*, *53*(6), 607–618. https://doi.org/10.1080/2372966X.2024.2424147

Savolainen, T. (2023). A safe learning environment from the perspective of Laurea University of applied sciences safety, security and risk management students and staff. *Heliyon*, *9*(3), e12836. https://doi.org/10.1016/j.heliyon.2023.e12836

Tandika, P., & Ndijuye, L. G. (2022). The question of university graduates' employability: Are the students aware of the employers' preferences. *Higher Education, Skills and Work-Based Learning*, *12*(3), 588–603. https://doi.org/10.1108/HESWBL-05-2021-0101

Türközü, T., & Dinçer, S. (2025). Investigation of teachers' instructional material development literacy in terms of knowledge and perception. *Discover Education*, *4*(1), 339. https://doi.org/10.1007/s44217-025-00823-w

Yang, Q., Zimmermann, K., Bartholomew, C. P., Purtell, K. M., & Ansari, A. (2024). Preschool Classroom Age Composition and Physical Literacy Environment: Influence on Children's Emergent Literacy Outcomes. *Early Education and Development*, *35*(7), 1483–1500. https://doi.org/10.1080/10409289.2023.2247953

Zahid, A., & Nawab, A. (2025). Teaching strategies influencing learning strategies: Exploration of teaching and learning practices in a higher education context in Pakistan. *Social Sciences & Humanities Open*, *11*, 101442. https://doi.org/10.1016/j.ssaho.2025.101442

Zamiri, M., & Esmaeili, A. (2024). Strategies, Methods, and Supports for Developing Skills within Learning Communities: A Systematic Review of the Literature. *Administrative Sciences*, *14*(9), 231. https://doi.org/10.3390/admsci14090231