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Artificial Intelligence (AI) revolution in skills-based education: Investigating the teachers' instructional adaptation and students' engagement and outcomes

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ABSTRACT

This study investigated the integration of Artificial Intelligence (AI) in Technical-Vocational-Livelihood (TVL) education, focusing on teacher adaptation, student engagement, and learning outcomes. Employing a descriptive-correlational design, data were collected from 96 TVL teachers and 202 students at Compostela National High School and Compostela Science and Technology High School during the 2025–2026 academic year using validated questionnaires. Findings revealed that teachers integrated AI tools to a high extent, particularly for lesson planning, ethical instruction, and administrative tasks. Students demonstrated positive perceptions and active utilization of AI, with high awareness of ethical guidelines. AI tools showed a significant positive impact on learning outcomes, especially in fostering critical thinking, task efficiency, and independent learning. Correlation analyses indicated that students' utilization of AI tools significantly correlated with improved learning outcomes, while teachers' instructional strategies did not show a significant direct relationship with either student AI use or learning outcomes. The study concludes that student-centered AI engagement is pivotal for enhancing skills-based education. Based on these findings, the researchers recommend the development and implementation of an AI-Enhanced TVL Lesson Plan and Resource Toolkit. This output aims to provide structured, context-sensitive instructional materials that guide effective AI integration, support teacher professional development, and amplify meaningful student learning in vocational education.

Keywords: Vocational Education,Instructional Strategies and Tools, Artificial Intelligence (AI) Tools, Learning Outcomes, Descriptive Correlation, AI-Enhanced TVL Lesson Plan and Resource Toolkit

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INTRODUCTION

The rapid advancements in technology have ushered in a new era of education, where artificial intelligence (AI) is increasingly being integrated into classroom management and student engagement. AI tools such as adaptive learning platforms, automated grading systems, and virtual teaching assistants are transforming traditional teaching methodologies by providing personalized learning experiences and streamlining administrative tasks. This integration addresses the growing need for innovative strategies to enhance educational outcomes and prepare students for a technology-driven world.

Globally, studies have highlighted the transformative potential of AI in education, yet significant gaps remain in understanding its contextual applications. For instance, Chen et al. (2023) found that while AI tools improved personalized learning experiences in developed countries, challenges related to equity and access persisted in underprivileged regions. Similarly, Kumar and Singh (2022) reported that many educators lacked sufficient training to effectively use AI tools, leading to underutilization of these technologies. These studies underscore the need for localized research to address disparities and optimize AI integration for diverse educational settings.

In the Philippine context, the integration of AI in education is still in its nascent stage. A study by Cruz and Santos (2023) revealed that while some private schools in urban areas have begun using AI tools, public schools face significant barriers such as limited funding and infrastructure. Moreover, De la Cruz et al. (2022) emphasized the lack of teacher preparedness and professional development programs to support AI adoption in public schools. These findings point to the need for focused research on bridging these gaps to ensure inclusive and effective AI implementation in Philippine classrooms.

Locally, in the Compostela National High School, there is limited empirical evidence on the adoption and impact of AI tools in education. Most schools in the district still rely on traditional teaching methods, with minimal exposure to AI-driven educational technologies. Furthermore, some teachers expressed interest in using AI tools, they lacked access to resources and training to do so effectively. This underscores the importance of localized studies to identify specific needs and develop tailored interventions for AI integration in the district.

This study aims to fill this research gap by examining the relationship between Technical-Vocational-Livelihood (TVL) teachers' instructional strategies involving AI, students' perceptions and use of AI tools, and the resulting impact on students' learning outcomes at Compostela National High School-Day Class, Evening Class and Compostela Science and Technology High School during the 2025–2026 academic year. The findings will inform the development of an AI-Enhanced TVL Lesson Plan and Resource Toolkit designed to support the effective integration of AI in skills-based education, ensuring both teacher preparedness and meaningful student engagement.

Statement of the Problem

This research aimed to determine the relationship between the strategies and tools employed by Technical-Vocational-Livelihood (TVL) teachers and the perception and utilization of AI tools by students, and how these factors collectively impact student learning outcomes in skills-based education at Compostela National High School-Day Class and Evening Class and Compostela Science and Technology High School during the academic year 2025 – 2026 as basis for the development of AI-Enhanced TVL Lesson Plan and Resource Toolkit.

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Specifically, this answered the following questions:

1. What are the strategies and tools teachers in vocational education employ to integrate AI into their curriculum and academic instruction?
2. How do students in vocational-related fields perceive and utilize AI tools to enhance their engagement and performance in lessons, homework, and projects?
3. What is the impact of Artificial Intelligence (AI) tools on the learning outcomes of students in vocational-related fields?
4. Is there a significant correlation between: teachers' instructional strategies and tools;students' utilization of AI tools; and student learning outcomes in skills-based education?
5. Based on findings, what particular AI-Enhanced TVL Lesson Plan and Resource Toolkit shall be developed?

METHODOLOGY

Research Design

The descriptive correlational design was employed for this study as it allowed for the examination of relationships between variables without manipulating them. By employing a quantitative survey questionnaire, the study systematically collected and analyzed data to explore how the integration of AI tools influenced classroom management and student engagement. The use of questionnaires enabled the collection of numerical data, which were statistically analyzed to identify correlations or trends. This approach enhanced objectivity and allowed for generalization to similar educational settings.

Respondents and Locale of the Study

This study was conducted among 298 respondents, consisting of 96 teachers (32.21%) and 202 students (67.79%) from Compostela National High School Day and Evening Classes and Compostela Science and Technology High School in Compostela, Cebu. These schools were selected because they represent both general and science-technology-oriented public secondary education and provide diverse learning contexts for examining AI integration in Technical-Vocational-Livelihood (TVL) programs. The respondents were chosen due to their direct involvement in the teaching and learning process, enabling the study to gather valuable insights on the use of AI tools, teacher adaptation, student engagement, and the development of a contextualized AI-Enhanced TVL Lesson Plan and Resource Toolkit.

Research Instrument

The study utilized a structured questionnaire consisting of three parts to gather data from TVL teachers and students of Compostela National High School and Compostela Science and Technology High School. The instrument measured teachers' AI integration strategies and tools, students' perceptions and utilization of AI, and the impact of AI on learning outcomes using four-point Likert scales. The questionnaire was developed based on the study objectives, DepEd TVL curriculum, and related literature, and underwent expert validation and pilot testing to ensure validity and reliability. The data gathered served as the

basis for answering the research questions, testing relationships among variables, and developing the proposed AI-Enhanced TVL Lesson Plan and Resource Toolkit.

Data Analyses Procedure

The study followed three phases: preliminary, data gathering, and post-data gathering. During the preliminary stage, the necessary approvals were secured, respondents were selected, and orientations were conducted. In the data gathering stage, questionnaires were distributed, confidentiality was ensured, and responses were collected within the prescribed period. During the post-data gathering stage, completed questionnaires were verified, organized, and analyzed using appropriate statistical tools. The data were treated using frequency and percentage, weighted mean, standard deviation, and Pearson Product-Moment Correlation Coefficient (r) to describe the respondents, determine the levels of the variables, measure response variability, and examine the significant relationships among teachers' AI integration strategies, students' AI utilization, and learning outcomes at the 0.05 level of significance.

RESULTS AND DISCUSSION

Strategies and tools teachers in vocational education employ to integrate AI into their curriculum and academic instruction

The study found that TVL teachers demonstrated a high extent of AI integration in their instructional practices, with an overall mean of 2.55 (SD = 1.04). The highest-rated practices were teaching ethical and responsible AI use (M = 2.72, SD = 1.03), utilizing AI for lesson planning and instructional material preparation (M = 2.67, SD = 1.05), and automating administrative tasks (M = 2.63, SD = 1.03), while the integration of AI into hands-on TVL activities obtained the lowest mean (M = 2.39, SD = 1.06), although it remained at a high extent level. These findings indicate that teachers generally viewed AI as a valuable tool for enhancing instruction, improving efficiency, and supporting ethical technology use, while its application in practical vocational tasks was still developing. The results highlight the need for continued professional development and the implementation of AI-responsive instructional resources, such as the proposed AI-Enhanced TVL Lesson Plan and Resource Toolkit. These findings are consistent with the studies of Holmes et al. (2022), who emphasized the role of AI in lesson planning, assessment, and differentiated instruction; Zhai, He, and Li (2021), who found that AI supports diverse learner needs and curriculum alignment; and UNESCO (2023), which underscored the importance of teacher competence, ethical awareness, and institutional support for effective AI integration in education.

Students in vocational-related fields perceive and utilize AI tools to enhance their engagement and performance in lessons, homework, and projects

Data further revealed that students generally agreed on the usefulness and positive impact of AI tools in learning, with an overall mean of 2.90 (SD = 0.73). The highest-rated indicator was awareness of DepEd policies and school guidelines on the ethical use of AI (M = 3.22, SD = 0.76), followed by the use of AI for personalized feedback (M = 2.98, SD = 0.78), instant explanations and practice activities (M = 2.95, SD = 0.71), and generating ideas and project drafts (M = 2.94, SD = 0.68). Although the belief that AI improves learning and retention more than traditional methods obtained the lowest mean (M = 2.79, SD = 0.74), it remained within the agree category. These findings indicate that students viewed AI as a

valuable learning support tool that enhances efficiency, creativity, understanding, and independent learning while maintaining responsible and ethical use. The results support the integration of AI-enhanced instructional resources and structured learning activities in TVL education and are consistent with the findings of Zawacki-Richter et al. (2020), who reported improvements in self-regulated learning and academic achievement through AI-supported environments; Chen, Xie, and Hwang (2021), who highlighted the benefits of personalized feedback and adaptive support; and UNESCO (2023), which emphasized the importance of ethical AI awareness for maximizing educational benefits and minimizing risks.

Impact of Artificial Intelligence (AI) tools on the learning outcomes of students in vocational-related fields

The research shows that AI tools had a high impact on students' learning outcomes, with an overall mean of 2.51 (SD = 0.82). The highest-rated effects were on promoting critical thinking and fact-checking (M = 2.76, SD = 0.84), increasing efficiency in completing practical projects while maintaining quality (M = 2.72, SD = 0.88), and enhancing contributions to group work (M = 2.70, SD = 0.88). In contrast, improvements in academic grades (M = 2.23, SD = 0.75), readiness for TESDA National Certification assessments (M = 2.27, SD = 0.85), and real-world problem-solving (M = 2.30, SD = 0.77) were perceived to have only a moderate effect. These findings suggest that AI contributes more significantly to the development of higher-order and transferable vocational competencies, such as critical thinking, collaboration, efficiency, and independent learning, than to traditional academic performance measures. The results highlight the importance of integrating AI into competency-based and TESDA-aligned learning activities to strengthen vocational skill development and certification readiness. These findings are consistent with the studies of Kwak (2025) and Ninghardjanti et al. (2025), which reported improvements in learner engagement and skill mastery through AI-supported learning environments, and Jaya et al. (2024), who emphasized the effectiveness of AI in enhancing vocational competencies through personalized feedback, ethical utilization, and competency-oriented instructional design.

Teachers' instructional strategies and tools and students' utilization of AI tools, and the resulting student learning outcomes in skills-based education

The result of this study revealed that teachers' instructional strategies and AI integration practices (M = 2.55, SD = 1.04) and students' utilization of AI tools (M = 2.90, SD = 0.74) were not significantly related, as evidenced by a negligible positive correlation (r = 0.09) and a p-value (0.392) greater than the 0.05 level of significance. Consequently, the null hypothesis was accepted, indicating that teachers' AI-related instructional practices did not significantly influence students' AI utilization. This suggests that students' use of AI tools may be shaped more by personal motivation, peer influence, technological accessibility, and external digital environments than by classroom practices alone. The findings highlight the need for structured AI integration strategies, including guided activities, explicit modeling, digital literacy programs, and school-wide AI policies to align students' AI use with educational objectives. These results support the development of the proposed AI-Enhanced TVL Lesson Plan and Resource Toolkit and are consistent with the findings of Monserate (2018) and Valverde-Berrocoso et al. (2022), which emphasized the influence of factors beyond teacher practices on students' technology utilization, as well as Selwyn (2022), who

underscored the importance of structured guidance and digital literacy in promoting meaningful technology adoption for learning.

Teachers' instructional strategies and tools and student learning outcomes in skills-based education

The teachers' instructional strategies and AI integration practices (M = 2.55, SD = 1.04) and students' learning outcomes in skills-based education (M = 2.51, SD = 0.84) were not significantly related, as indicated by a negligible positive correlation (r = 0.03) and a p-value (0.689) that exceeded the 0.05 level of significance. Consequently, the null hypothesis was accepted, showing that teachers' AI-integrated instructional practices did not significantly influence students' learning outcomes. This suggests that vocational learning outcomes may be shaped by other factors such as learner motivation, prior competencies, access to technological resources, and the practical nature of TVL activities. The findings emphasize the need for a more comprehensive approach that combines effective instruction, learner support, authentic industry-based tasks, and adequate resources to improve student performance. These results support the development of the proposed AI-Enhanced TVL Lesson Plan and Resource Toolkit and are consistent with the findings of Casinillo (2018) and Noguera et al. (2024), which highlighted the influence of mediating factors on vocational learning outcomes, Pangan (2022), who noted the limited direct effect of instructional strategies on competency achievement, and He (2025), who emphasized the importance of aligned assessments, learner support, and outcome-based approaches in Technical and Vocational Education and Training (TVET).

Correlation between students' utilization of ai tools, and student learning outcomes in skills-based education

Table 6 revealed a statistically significant moderate positive relationship between students' utilization of AI tools (M = 2.90, SD = 0.74) and their learning outcomes in skills-based education (M = 2.51, SD = 0.84), as indicated by a Pearson correlation coefficient of r = 0.47 and a p-value of 0.00, which was lower than the 0.05 level of significance. Consequently, the null hypothesis was rejected, demonstrating that increased utilization of AI tools was associated with improved learning outcomes among TVL students. These findings suggest that AI supports skill acquisition, learning efficiency, critical thinking, problem-solving, project completion, and independent learning, thereby contributing positively to vocational education outcomes. The results further support the integration of AI literacy and structured AI-assisted learning activities within the DepEd TVL curriculum, aligning with learner-centered instruction, digital literacy development, and Industry 4.0 workforce preparation. The findings are consistent with the studies of Kwak (2025) and Madanchian et al. (2025), which highlighted the role of AI in enhancing critical thinking, personalized learning, and vocational skill development; Alshammari (2024), who reported improved competency mastery and learner engagement through active AI utilization; and Sasikala (2024), who emphasized the positive effects of AI-supported learning tools on educational outcomes and the importance of integrating student-centered AI literacy initiatives in Technical and Vocational Education and Training (TVET).

TVL teachers integrated AI tools into their instruction to a high extent. The most frequently used strategies included teaching ethical AI use, incorporating AI into lesson planning, and automating administrative tasks. However, direct integration of AI into hands-on practical components received the lowest mean, indicating room for growth in applying AI within skills-based activities.

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Students agreed that AI tools positively supported their learning. They demonstrated strong awareness of ethical guidelines and actively used AI for instant explanations, project ideation, and personalized feedback. Students perceived AI as beneficial for efficiency, comprehension, and independent learning.

AI tools had a high overall impact on learning outcomes. The most significant effects were observed in critical thinking, task efficiency, collaboration, and independent learning. Improvements in grades, TESDA certification readiness, and real-world problem-solving were perceived as moderate.

No significant correlation was found between teachers' instructional strategies and students' utilization of AI tools. No significant correlation was found between teachers' instructional strategies and student learning outcomes . A significant positive correlation was found between students' utilization of AI tools and their learning outcomes.

Conclusion

The study concludes that while TVL teachers are actively integrating AI into their instruction and students are positively engaging with AI tools, teachers' instructional strategies alone do not directly influence students' AI use or their learning outcomes. Instead, students' independent and purposeful utilization of AI tools significantly contributes to improved learning outcomes in skills-based education. This highlights the importance of student-centered AI adoption and the need for structured, guided AI integration that aligns instructional practices with meaningful student engagement.

Recommendations

Based on the findings, it is recommended that the AI-Enhanced TVL Lesson Plan and Resource Toolkit be developed and implemented. This toolkit should provide teachers with contextualized, ready-to-use lesson plans and AI-integrated instructional resources that align with DepEd's TVL curriculum. It should emphasize hands-on, practical AI applications, foster ethical and responsible use, and include student-centered activities that promote independent learning, critical thinking, and skill mastery. The toolkit will serve as a practical guide to enhance both teaching effectiveness and student engagement in vocational education.

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