

# Learning Style-Based Differentiated Instruction for an Improved Student's Life and Career Skills in Technology and Livelihood Education

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## Abstract

This study examined the effectiveness of learning style-based differentiated instruction in improving the life skills, career skills, and academic performance of Grade 8 students in Technology and Livelihood Education at Leonarda D. Vera Cruz National High School. The study was anchored on Multiple Intelligences Theory, Experiential Learning Theory, the VAK Learning Styles Model, Dual Coding Theory, and Bloom's Taxonomy, which supported the use of varied instructional strategies for visual, auditory, and kinesthetic learners. A quasi-experimental research design using a single-group pretest–posttest approach was employed. Thirty Grade 8 students were selected through purposive sampling. The study used a learning style inventory, weekly assessment tools, life skills and career skills assessments, and pretest and posttest instruments. Data were analyzed using descriptive statistics and a paired samples t-test. Findings revealed that kinesthetic learning was the most preferred learning style, while visual and auditory learning styles were also evident. Students demonstrated high levels of life skills in problem-solving, critical thinking, and decision-making, as well as high levels of career skills in technical skills proficiency, entrepreneurial skills, and practical application in real-world scenarios. Pretest results indicated a moderate level of performance, whereas posttest results showed a high level of performance. The paired samples t-test showed a significant increase from the pretest mean of 6.20 to the posttest mean of 11.23, with a significant difference at  $p = 0.000$ , leading to the rejection of the null hypothesis. The study concluded that learning style-based differentiated instruction positively affects students' academic performance and skill development in TLE. It recommended the integration of differentiated instruction, hands-on and experiential activities, varied teaching strategies, career-oriented activities, teacher workshops, curriculum support, and further research. The study supports SDG 4 – Quality Education and SDG 8 – Decent Work and Economic Growth by promoting inclusive instruction and strengthening students' readiness for future employment and self-sufficiency. Its sustainability impact lies in improving educational practice, supporting workforce preparation, and strengthening institutional approaches to learner-centered TLE instruction.

**Keywords:** Academic Achievement, Career Skills, Differentiated Instruction, Kinesthetic Learning, Learning Styles, Life Skills, Technology and Livelihood Education

## 1. Introduction

Education in the twenty-first century is expected to prepare learners not only for academic success but also for practical, social, and occupational demands. Technology and Livelihood Education respond to this need by combining vocational learning, entrepreneurship, technical competencies, and problem-solving skills that support students' preparation for future careers (Calma, 2024). However, students differ in the way they process and respond to instruction. Some learn more effectively through visual materials, others through auditory discussion, and others through hands-on or kinesthetic activities. As Taş (2024) indicated, varying instructional methods that target learning preferences improve engagement and success. Differentiated instruction addresses these differences by adapting content, process, product, and assessment according to learners' readiness, interests, and learning profiles. In vocational and technical education, DI supports skill development and engagement by making instruction more flexible and responsive to student needs (Compen, Verstegen, Maussen, Hulsman, & Dolmans, 2025). Since TLE requires both theoretical understanding and hands-on performance, differentiated instruction is especially relevant in helping students develop life skills such as problem-solving, critical thinking, and decision-making, as well as career skills such as technical proficiency, entrepreneurship, and practical application.

The literature identifies differentiated instruction as an inclusive and flexible approach that recognizes learner diversity. It challenges the one-size-fits-all model by encouraging teachers to adjust instruction according to students' readiness, learning profiles, and interests (Tomlinson, 2014). Successful differentiation depends on teachers' continuous assessment of learners' needs and their ability to modify instruction accordingly, as emphasized by Langelan (2024). Eikeland (2022) further affirmed that differentiated instruction is strongest when grounded in constructivist principles and inclusive classroom practices. Beyond academic outcomes, DI also supports psychosocial development by improving well-being,

academic self-image, and peer integration (Pozas et al., 2021). It also promotes engagement in diverse classrooms (Jørgensen, 2021), while teacher education must develop educators' capacity to assess and adapt the curriculum effectively (Estaiteyeh, 2023). Learning styles are also emphasized as an important consideration in instructional planning. Some studies report that students' motivation, emotional engagement, and academic success improve when learning preferences are recognized and teachers provide varied learning opportunities (Seemiller et al., 2021; Koç, 2025). Aboregela (2023) found that read/write and visual learners outperformed kinesthetic learners in a medical education context, while Muniyapillai et al. (2023) noted the relationship among learning style, teaching style, and achievement. Clinton-Lisell and Litzinger (2024) offered a balanced view by noting debates around the learning styles hypothesis, but still emphasized that flexible teaching approaches can improve engagement and metacognitive skills. Koç (2025) also connected learning styles, personal variables, family-related factors, and cognitive achievement among secondary learners.

The literature further shows that multimodal and learner-centered instruction supports educational outcomes across contexts. Cuizon et al. (2022) found that Filipino college students with multimodal learning preferences showed flexibility and persistence in online learning. Maniteze (2025) similarly reported that recognizing students' preferred learning styles improved performance and confidence among secondary students in Rwanda. Gangadharan (2025) found that experiential and kinesthetic strategies improved understanding and skill mastery among health-sciences students in Oman, while Udu and Abughdyer (2025) showed that modifying English language teaching according to dominant learning styles improved understanding and skills. In TLE and vocational education, differentiated instruction is especially relevant because these fields require both cognitive and psychomotor development. Compen et al. (2025) mention that differentiation in vocational contexts must balance outcome-based competencies with learner diversity through adaptive grouping, level-based tasks, and formative evaluation. In the same way, Rufaidah et al. (2025) showed that multiliteracies-based differentiation in Indonesian vocational education improved occupational communication and language teaching. Irawan et al. (2024) found that differentiated instruction in English for Specific Purposes improved learning outcomes in vocational education, while Hiruy (2022) showed that contextual learning helps reduce the theory-practice gap and improve employability. Recent regional and international studies also link differentiated instruction with life and career readiness. Fitralindi et al. (2024) showed that DI improved students' precision and confidence in Computer Numerical Control lessons. Murdin et al. (2025) and Agustean et al. (2025) confirmed that differentiated strategies in vocational English improved literacy, self-efficacy, and class involvement. A. Setiadiningsih and Sutanto (2024) found that differentiated learning enhanced vocational students' employability skills, while Yani et al. (2025) showed that DI-based digital modules supported self-paced practical skill acquisition. Abdurrahman et al. (2023) also demonstrated that differentiated strategies improved conceptual understanding and retention in technical subjects.

Life skills education is presented as essential to holistic learner development. It includes critical thinking, communication, sound decision-making, self-awareness, social awareness, and positive social attitudes. Life skills education supports inclusive and equitable education under the Sustainable Development Goals framework (Hvalby, 2024; Erbaş, 2025). Erbaş (2025) emphasized the importance of psychosocial life skills for disadvantaged learners, while Isaksen (2025) described life skills education as preparation for social responsibility and employment. Tagat et al. (2025) reported gains in socio-emotional learning, self-efficacy, and school engagement from life skills interventions, while Aromatario et al. (2024) identified stress management, emotional intelligence, and communication as major components of adolescent life skills programs. Godana et al. (2023) documented improvements in negotiation skills, responsible behavior, and reproductive health knowledge, while ter Harmsel-Nieuwenhuis et al. (2025) identified skills for life as strategic assets across learning environments. Pedditzi (2023) linked life skills self-efficacy with school satisfaction, and Antony (2023) identified critical thinking, communication, and decision-making as key post-school competencies. Sardar and Paria (2025) found that life skills education benefits tertiary students with and without disabilities, while Hvalby (2024) noted that schools with explicit life skills policies perform better in student participation, resilience, and moral responsibility.

Career skills development is also central to TLE. Kholifah (2025) highlighted digital employability in vocational education, particularly through industry-specific digital applications and online collaboration. G. B. Estilo (2025) argued that vocational training promotes confidence and proficiency in career pathways such as entrepreneurship, food services, and technical programs. A. Setiadiningsih and Sutanto (2024) found that differentiated learning developed employability skills such as problem-solving, teamwork, flexibility, and adaptability.

Locally, the study is situated at Leonarda D. Vera Cruz National High School and focuses on Grade 8 students enrolled in TLE. The local context is important because the study seeks to determine how learning style-based differentiated instruction can improve students' life skills, career skills, and academic performance within an actual public secondary school setting. Nationally, the study responds to the role of TLE in the Philippine secondary curriculum as a subject that develops job-related skills, life skills, adaptability, self-reliance, and future career preparation (Galit et al., 2025; Calma, 2024). Globally, the study aligns with research on differentiated instruction, learning styles, vocational education, employability, and life skills development across different countries and learning contexts. Studies from Flanders and the Netherlands, Indonesia, Rwanda, Oman, India, Ethiopia, and other contexts show that differentiated instruction and life skills education are relevant

to inclusive education, practical skill development, self-efficacy, and employability (Compen et al., 2025; Irawan et al., 2024; Maniteze, 2025; Gangadharan, 2025; Tagat et al., 2025; Godana et al., 2023). These studies support the need to examine differentiated instruction in the Philippine TLE setting, where students must develop both academic and practical competencies.

The study is supported by theories that explain learner diversity, experiential learning, multimodal instruction, and higher-order thinking. The author's primary supporting theory is Howard Gardner's 1983 Multiple Intelligences Theory, which explains that students process information through different forms of intelligence and therefore benefit from varied instructional approaches. Vygotsky's (1978) Zone of Proximal Development (ZPD) supports differentiated instruction by emphasizing that meaningful learning occurs when instruction is aligned with learners' readiness. Gardner's (1983) Multiple Intelligences Theory and Kolb's (1984) Experiential Learning Theory further support the view that students differ in intellectual strengths and learning preferences. David Kolb focuses on the role of experience in learning in his framework (1984), which is especially relevant to kinesthetic learners and TLE activities requiring hands-on practice. The VAK Learning Styles model (Fleming, 1987) classifies learners as visual, auditory, or kinesthetic and provides the basis for designing instructional strategies that match students' preferred ways of learning. Allan Paivio's Dual Coding Theory (1971) supports the use of visual and auditory channels in instruction, especially for learners who benefit from images, graphs, written text, and explanations. Bloom's Taxonomy (1956) supports the development of higher-order skills such as critical thinking, problem-solving, and decision-making, which are important life skills in TLE. Conceptually, differentiated instruction serves as the independent variable, while the dependent variables include life skills, career skills, and academic performance. Life skills include problem-solving, critical thinking, and decision-making. Career skills include technical skill proficiency, entrepreneurial skills, and practical application of skills in real-world scenarios. Academic performance is measured through pretest and posttest results. This framework assumes that instruction aligned with visual, auditory, and kinesthetic learning preferences can improve students' engagement, competency development, and performance in TLE.

The reviewed literature establishes that differentiated instruction supports learner diversity, inclusive education, academic engagement, and practical skills development. However, the literature also points to the need for more context-specific empirical studies, especially in TLE and vocational education settings. The consolidated literature points to differentiated instruction as a way to manage learner heterogeneity and improve outcomes through content, method, and instruction aligned with readiness, interest, and learning profiles (Tomlinson, 2014; Eikeland, 2022). Studies also show that effective differentiation supports cognitive and emotional development (Pozas et al., 2021; Jørgensen, 2021) and requires continuous instructional judgment and adaptation (Langelaan, 2024; Estaiteyeh, 2023). In TLE and vocational education, experiential, hands-on, and context-driven learning are necessary to connect theory and practice (Hiruy, 2022; Irawan et al., 2024). The reviewed studies also identify the potential of differentiated instruction to attract learners, improve learning performance, and develop life and occupational competencies when properly implemented (Gheysens, 2023; Ramaila, 2025). The present study addresses this gap by examining the effect of learning style-based differentiated instruction on the life skills, career skills, and academic performance of Grade 8 students in TLE. Specifically, it focuses on students' visual, auditory, and kinesthetic learning preferences; their levels of problem-solving, critical thinking, and decision-making; their technical, entrepreneurial, and practical career skills; and the difference between pretest and posttest scores after exposure to differentiated instruction.

The study aligns most directly with SDG 4 – Quality Education because it focuses on inclusive, responsive, and learner-centered instruction. Differentiated instruction supports educational sustainability by addressing learner diversity and helping students participate meaningfully in classroom learning. The connection between life skills education and inclusive education is consistent with research linking life skills programs to the Sustainable Development Goals framework (Hvalby, 2024; Erbaş, 2025). The study also supports SDG 8 – Decent Work and Economic Growth because TLE develops career readiness, employability, technical competence, entrepreneurship, adaptability, and practical workplace-related skills. Literature on TLE and vocational education emphasizes the importance of employability, collaboration, communication, digital literacy, and problem-solving in preparing students for future work (Galit et al., 2025; Kholifah, 2025; Nugraha et al., 2025; R. M. Estilo, 2025). SDG 9 – Industry, Innovation and Infrastructure is also relevant because the study involves technology and livelihood education, practical skills development, differentiated digital learning, and technical-vocational readiness. Studies on CNC lessons, digital employability, online collaboration, and DI-based electronic modules show the role of technology-supported instruction in developing innovation-related competencies (Fitraldi et al., 2024; Kholifah, 2025; Yani et al., 2025). The study may also relate to SDG 3 – Good Health and Well-Being through its emphasis on life skills, emotional development, resilience, self-efficacy, and school satisfaction. Research on life skills education links these skills to socio-emotional learning, responsible behavior, emotional intelligence, and learner well-being (Tagat et al., 2025; Aromatario et al., 2024; Pedditzi, 2023; Hvalby, 2024). This study contributes to educational sustainability by promoting differentiated instruction as a responsive and inclusive teaching approach that can improve student engagement, learning outcomes, and skill development in TLE. It supports teachers in designing varied strategies for visual, auditory, and kinesthetic learners and helps schools strengthen instructional practices that respond to

learner diversity. The study also contributes to socio-economic and workforce sustainability by strengthening students' career skills, technical proficiency, entrepreneurship, and real-world application of knowledge. Since TLE prepares students for livelihood, employment, and self-reliance, improving instruction in this subject supports long-term employability and local economic participation. It further contributes to technological and innovation sustainability by encouraging teaching strategies that integrate technical skills, digital employability, practical training, and self-directed learning. Through differentiated instruction, students can develop competencies needed in changing workplace environments, particularly those involving technology, vocational practice, and applied problem-solving. Finally, the study supports public health and well-being sustainability through its focus on life skills such as critical thinking, problem-solving, decision-making, self-efficacy, resilience, and responsible behavior. These competencies help learners manage academic and real-life challenges. Institutionally, the study may guide teachers, school administrators, curriculum developers, and future researchers in improving TLE instruction and strengthening evidence-based practices for learner-centered education.

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## **2. Material and methods**

### **2.1 Research Design**

The study employed a quasi-experimental research design using a single-group pretest–posttest structure. This design was appropriate for examining changes in students' performance before and after an intervention when random assignment was not feasible (Creswell & Creswell, 2018; Fraenkel et al., 2019). The study aimed to determine the effect of differentiated instruction, aligned with students' dominant learning styles, on the development of life skills, career skills, and academic performance in Technology and Livelihood Education among Grade 8 students. The study began by identifying students' preferred learning styles as visual, auditory, or kinesthetic. Learning style inventories are commonly used in educational research to guide instructional planning and examine learner variability (Fleming, 1987). The results served as the basis for designing differentiated instructional strategies and analyzing the relationship between students' preferred learning styles and their academic performance. The intervention was conducted over three weeks, with each lesson emphasizing one learning modality: visual, auditory, and kinesthetic. As noted by Tomlinson (2014), differentiated instruction refers to teaching strategies shaped according to students' needs, readiness levels, and learning profiles. Each lesson maintained the same learning objectives while highlighting a specific modality. The modality focus was not disclosed to the participants to reduce bias and encourage authentic engagement. The effectiveness of the intervention was measured through pretest and posttest comparisons. The pretest gathered baseline data on students' knowledge and skills, while the posttest assessed changes in life skills, career skills, and academic proficiency in TLE after the intervention. The pre-test, post-test approach is a staple of quasi-experimental studies to determine the results of a given educational intervention (Fraenkel et al., 2019).

### **2.2 Locale of the Study**

The study was conducted at Leonarda D. Vera Cruz National High School, an educational institution located in Unisan, Quezon. The locale was selected because it offered Technology and Livelihood Education classes for Grade 8 students, which served as the setting for implementing learning style-based differentiated instruction.

### **2.3 Respondents of the Study**

The respondents of the study were Grade 8 students enrolled in Technology and Livelihood Education classes at Leonarda D. Vera Cruz National High School. The participants were selected because they represented the three learning modes considered in the study: visual, auditory, and kinesthetic. To qualify for participation, students had to be currently enrolled in Grade 8, be taking TLE, complete the learning style pre-assessment, and provide informed consent or assent in the case of minors.

### **2.4 Sample and Sampling Procedure**

The researcher used purposive sampling to select the respondents. This non-probability sampling technique involves choosing participants based on specific inclusion criteria (Creswell & Creswell, 2018; Etikan et al., 2016). It was used because the study required participants who could provide relevant data on the effects of differentiated instruction based on learning preferences. Purposive sampling was appropriate because the study considered students with varied learning styles. Including visual, auditory, and kinesthetic learners allowed the researcher to examine the effect of differentiated instruction on different learning preferences. This approach corresponds with studies suggesting the importance of considering learners' diversity in instructional design, as it promotes enthusiasm and helps develop learners' abilities and academic performance (A. Setiadiningsih & Sutanto, 2024).

### **2.5 Research Instrument**

The study used an assessment battery to identify students' learning patterns, life skills, career skills, and academic performance in TLE. The instruments included a learning style inventory, weekly assessment tools, and pretest and posttest instruments. The learning style inventory was used to classify students according to visual, auditory, or kinesthetic learning

preferences. The results guided the researcher in selecting appropriate differentiated teaching strategies. Weekly assessments were used to measure students' understanding of the TLE content and their ability to apply practical skills relevant to the subject. The pretest and posttest assessed students' acquisition of theoretical and practical TLE skills before and after the differentiated instruction intervention. The instruments also measured life skills such as critical thinking, problem-solving, and decision-making, as well as career skills such as technical skills, entrepreneurial skills, and practical application in real-life situations. The pretest measured students' initial knowledge and skills, while the posttest determined the changes after the intervention. The instruments were subjected to validity and reliability procedures. Experts in education and TLE examined the instruments to ensure that the appropriate constructs were measured, and revisions were made to improve clarity and precision. The reliability of the survey instrument was evaluated using Cronbach's alpha. Cronbach's alpha, a coefficient of reliability, estimates the degree of linear relationships between the items comprising the scale that back the same construct (Cronbach, 1951). Acceptable levels of research reliability were set at a coefficient value of 0.70 or higher (Taber, 2018). A pilot test was also administered to Grade 8 students who were not part of the main sample, since pilot testing helps clarify items and improve instrument quality (Fraenkel et al., 2019; Creswell & Creswell, 2018).

## **2.6 Data Gathering Procedure**

The data gathering procedure began with the preparation of the research instruments, including the learning style inventory and the pretest and posttest assessments. The instruments were reviewed by experts for content validity, refined based on their feedback, and pilot-tested with Grade 8 students who were not part of the main study. Permission to conduct the study was secured from the administration of Leonarda D. Vera Cruz National High School. After approval, the researcher obtained consent from participants and, when necessary, from their parents or guardians. The learning style inventory was then administered to determine each student's preferred learning style. After the pre-assessment, the researcher implemented differentiated instruction for three weeks. The first week focused on visual learning through diagrams, charts, and visual aids. The second week focused on auditory learning through verbal instruction, discussion, and auditory materials. The third week focused on kinesthetic learning through hands-on and experiential activities. Students were not informed of the learning style emphasis for each lesson to allow a more objective assessment of participation and achievement. At the end of each lesson, students completed short assessments to measure their understanding and application of the TLE content. These assessments included knowledge-based items and practical skill tasks. The results were used to examine students' learning achievement and the possible relationship between instructional modality and performance.

## **2.7 Data Analysis Techniques**

The collected data were organized and analyzed quantitatively to determine the effect of differentiated instruction on students' life skills, career skills, and academic performance in TLE. Descriptive statistics were used to summarize the learning style pre-assessment results and the pretest and posttest scores. Frequency, percentage, mean, and standard deviation were used to describe the distribution of students' preferred learning styles and the overall trends in achievement and skill development before and after the intervention. A paired samples t-test was used to compare the pretest and posttest scores of the participants. This statistical test is appropriate for determining whether there is a significant difference between two related measurements taken from the same group, such as scores obtained before and after an intervention (Fraenkel et al., 2019; Field, 2018). In this study, the paired t-test was used to determine whether differentiated instruction produced a statistically significant improvement in students' life skills, career skills, and academic achievement in TLE.

## **2.8 Ethical Considerations**

The study observed ethical procedures by securing permission from the school administration and obtaining informed consent from the participants and their parents or guardians when applicable. The consent process explained the purpose of the study and the confidentiality of the participants' information. These steps ensured that the data were gathered in an organized and ethical manner while protecting the rights and privacy of the respondents.

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# **3. Results and Discussion**

## **3.1 Preferred Learning Styles of the Respondents**

### **3.1.1 Visual Learning Style**

The respondents showed a positive preference for visual learning, with an overall mean of 3.16. All indicators were interpreted as "Agree," with mean scores ranging from 3.07 to 3.23. The highest-rated indicator showed that students preferred writing notes, highlighting texts, or drawing symbols when learning, while the lowest-rated indicator still showed that students followed TLE procedures more easily when shown visually. The standard deviations indicated that the responses were generally consistent. The result suggests that visual aids, diagrams, charts, written materials, and demonstrations help students understand TLE concepts and procedures. Aboregela (2023) supports this position, as he suggests that visual learners academically outperform others. The results of the study parallel the results of Clinton-Lisell

and Litzinger (2024), who state that there is still a debate about how teaching strategies should be aligned to learning styles; the teaching of different styles along with the use of a variety of visually stimulating materials can promote student active involvement and enhance their awareness of their own thinking. These findings also affirm the relevance of recognizing students' learning differences in planning instruction (Clinton-Lisell & Litzinger, 2024; Koç, 2025). According to Taş (2024), incorporating knowledge of learning styles into differentiated instruction gives teachers the opportunity to design and implement learning experiences that are more effective and empowering in order to skillfully improve participation and build a more inclusive learning environment.

### **3.1.2 Auditory Learning Style**

The respondents also demonstrated an auditory learning preference, although it was less dominant than the other learning styles, with an overall mean of 2.98. All indicators were interpreted as "Agree," with means ranging from 2.87 to 3.07. The highest-rated indicator showed that students preferred TLE instructions to be read aloud before starting tasks, while the lowest-rated indicator concerned oral recitation and group sharing. The results indicate that auditory strategies are present among respondents but are practiced only to a moderate degree. The findings imply that verbal explanation, discussion, questioning, and listening activities remain useful in TLE instruction, but they should be balanced with other instructional approaches. Similar to the findings of Muniyapillai et al. (2023), the current findings show that students exposed to multiple teaching methods, including auditory methods, may experience better academic outcomes than those exposed to a single approach. Also, Clinton-Lisell and Litzinger (2024) stated that while teaching methods used individually based on a single preferred learning style/teaching style may not achieve high academic success, they may still achieve high academic success if multiple teaching methods and learning strategies are used. Also, Udu and Abughdyer (2025) state that improvement of auditory learning teaching methods may be useful in the improvement of advocated comprehension and communication in teaching learning experiences (TLE) that are language-driven and participatory.

### **3.1.3 Kinesthetic Learning Style**

Kinesthetic learning emerged as the most dominant learning style among the respondents, with an overall mean of 3.38. All indicators were interpreted as "Strongly Agree," with means ranging from 3.30 to 3.53. The highest-rated indicator showed that students understood the lesson better when they performed the task, while the lowest-rated indicators still confirmed strong preference for performing TLE tasks and applying lessons in real-life situations. The standard deviations showed that students had similar perceptions of the value of kinesthetic learning. The result indicates that students learn TLE more effectively through hands-on, active, practical, and experiential activities. Gangadharan (2025) argued that the students who benefit from experiential and kinesthetic learning methods advocate for the mastery of the concepts taught and the skills required, and this explains a positive endorsement of the present result. In the same vein, A. Setiadiningsih and Sutanto (2024) mentioned that vocational learners demonstrate improved problem-solving, adaptability, and employability skills when differentiated instruction with practical activities is used. Additionally, Fitrialdi et al. (2024) argued that differentiated instruction in the teaching of practical technical subjects facilitates learners' performance, confidence, and accuracy in the exercising of the skills. These findings show the importance of hands-on and activity-based instruction in TLE.

## **3.2 Life Skills Under Differentiated Instruction**

### **3.2.1 Problem-Solving Skills**

The respondents demonstrated a positive level of problem-solving skills under differentiated instruction, with an overall mean of 3.67. Most indicators were interpreted as "Agree," while one indicator was interpreted as "Neutral." The highest-rated indicator showed that students could reflect on solutions and learn from mistakes to solve future problems better. The lowest-rated indicator showed that students had more difficulty breaking a big problem into smaller, easier steps, although the overall result still reflected a favorable level of problem-solving skill. The findings suggest that differentiated instruction supports students' ability to identify problems, consider solutions, use resources, seek help, and stay motivated in solving difficult tasks. As emphasized in the literature, the development of life skills results in greater adaptability and self-efficacy in students, while also improving the students' learning outcomes (Erbaş, 2025; Hvalby, 2024). Differentiated instruction has also been shown to help develop higher-order thinking skills through the stimulation of various learning needs (Jørgensen, 2021). E. Setiadiningsih and Sutanto (2024) substantiated this finding by noting that context and individualized instruction promoted problem-solving and adaptability amongst vocational students. Moreover, Erbaş (2025) noted that the education of life skills, and problem-solving in particular, enables students' resilience and ability to tackle challenges in the real world, reiterating the point that differentiated teaching in TLE is not just about passing exams.

### **3.2.2 Critical Thinking Skills**

The respondents showed a positive level of critical thinking skills, with an overall mean of 3.80. All indicators were interpreted as "Agree." The highest-rated indicator showed that students checked facts and information before accepting them as true, while the lowest-rated indicators were related to identifying assumptions or biases and evaluating whether information was reliable. Despite these relatively lower scores, the overall result indicates that students practiced critical thinking under differentiated instruction. The results suggest that differentiated instruction encourages students to ask

questions, analyze information, compare ideas, support opinions with evidence, and remain open to new information. This is echoed by Antony (2023), considering critical thinking an invaluable skill needed for academic and professional success. Also, Hvalby (2024) noted skills for life education including critical thinking, helps improve student engagement, resilience, and learning. Additionally, E. Setiadiningsih and Sutanto (2024) stated that in vocational education, differentiated instruction improves critical thinking and flexibility of learners through active and problem-based learning. These findings support the use of student-centered strategies in TLE to strengthen higher-order thinking.

### **3.2.3 Decision-Making Skills**

The respondents demonstrated a positive level of decision-making skills, with an overall mean of 3.82. All indicators were interpreted as “Agree.” The highest-rated indicator showed that students learned from the results of their past decisions, while other highly rated indicators showed that students thought about possible outcomes and considered how their decisions affected others. The lowest-rated indicator still remained within the “Agree” level and involved avoiding decisions without thinking them through. The result indicates that differentiated instruction helps students evaluate choices, take responsibility, adjust decisions when new information appears, and make independent decisions when needed. This goes hand in hand with Antony (2023), who stated that decision-making is a fundamental life skill that students need to be able to function efficiently in personal and professional situations. Also, in life skill education, Isaksen (2025) stated that decision-making prepares students for citizenship and employability by equipping students with the ability to react to situations. Additionally, E. Setiadiningsih and Sutanto (2024) state that decision-making skills can be developed through differentiated instruction by providing a context that is centered on the individual learner and promotes active engagement and thinking.

## **3.3 Career Skills Under Differentiated Instruction**

### **3.3.1 Technical Skills Proficiency**

The respondents showed a positive level of technical skills proficiency, with an overall mean of 3.74. All indicators were interpreted as “Agree.” The highest-rated indicator showed that students could follow correct steps and safety procedures during practical activities, while the lowest-rated indicator showed that students were less confident in accomplishing TLE tasks within the required time. Overall, students demonstrated favorable technical competence in performing TLE-related tasks, using tools and materials, following instructions, and demonstrating skills. The findings suggest that differentiated instruction improves technical skill development by allowing students to learn through varied, practical, and skill-based activities. The literature states that the development of career skills is best achieved at the intersection of instruction that is geared toward practical application and needs of the learners that allow them to develop the skills of problem-solving, flexibility, and technical skills (Arroz et al., 2025; Galit et al., 2025). Also, differentiated instruction has been proven to enhance the acquisition of skills by providing students with various learning opportunities that suit their varied learning profiles and stimulate their active participation (Fitrialdi et al., 2024; E. Setiadiningsih & Sutanto, 2024). According to Fitrialdi et al. (2024), the use of differentiated instruction improves the students' skill precision, performance, and confidence. Besides, it is observed by Arroz et al. (2025) that the use of activity-based and student-centered pedagogy fosters the development of students' technical competencies. Furthermore, Galit et al. (2025) highlighted the need to incorporate 21st-century skills into TLE teaching, specifically the technical and adaptable skills, which is crucial for students' prospective employment.

### **3.3.2 Entrepreneurial Skills**

The respondents demonstrated a positive level of entrepreneurial skills, with an overall mean of 3.66. All indicators were interpreted as “Agree.” The highest-rated indicator showed that students could budget or plan simple expenses for a small project or product. The lowest-rated indicator showed that students had relatively lower confidence in estimating whether a product or service could be profitable. Overall, the respondents showed favorable entrepreneurial awareness, creativity, initiative, risk-taking, product quality awareness, and business idea presentation skills. The findings indicate that differentiated instruction can support entrepreneurial skill development by exposing students to learner-centered and practical activities. R. M. Estilo (2025) asserted that the vocational training programs that are precisely executed increase students' self-efficacy and skills in the entrepreneurial and technical fields. In the same context, Kholifah (2025) stated that technology-based teaching and learning improve employability and entrepreneurial skills and prepare students for the real world by providing the opportunity to develop and improve adaptability, creativity, and the ability to analyze and solve problems. In addition, Nugraha et al. (2025) stated that vocational education is very important in teaching generic employability skills, in particular communication, collaboration, and decision-making, because they are the core of entrepreneurship. These results show that differentiated instruction strengthens students' capacity to connect TLE learning with entrepreneurial readiness.

### **3.3.3 Practical Application in Real-World Scenarios**

The respondents showed a positive level of practical application of skills in real-world scenarios, with an overall mean of 3.79. All indicators were interpreted as “Agree.” The highest-rated indicator showed that students believed TLE learning could help them succeed in a future career, while the lowest-rated indicator involved solving simple work-related problems

using TLE knowledge. The results indicate that students were able to connect TLE skills to real-world tasks, workplace-like activities, time management, collaboration, and future livelihood opportunities. The findings show that differentiated instruction supports students' ability to transfer classroom learning into practical and real-life settings. The result agrees with Hiruy (2022), who noted that contextualized and experiential learning in vocational education bridges theory and practice because it improves learners' practical competencies. Likewise, Arroz et al. (2025) noted that learning activities and projects strengthen students' real-life skills and career prospects. In addition, Fitrialdi et al. (2024) state that students' practical and confident task accomplishment, especially in real-life situations, improves with differentiated learning in the technical and vocational fields. These findings confirm the value of real-world and experiential activities in TLE.

### **3.4 Academic Performance Before and After Differentiated Instruction**

#### **3.4.1 Pretest Scores Before Differentiated Instruction**

Before the implementation of differentiated instruction, most respondents across the visual, auditory, and kinesthetic groups were placed in the "Less Master" and "Quite Master" categories. Among visual learners, the majority were in the "Less Master" level at 60.0%, followed by 26.7% in the "Quite Master" level. Among auditory learners, 56.7% were in the "Less Master" level and 36.7% were in the "Quite Master" level. Among kinesthetic learners, 56.7% were in the "Quite Master" level and 30.0% were in the "Less Master" level. No respondent reached the "Expert" level before the intervention. These results indicate that students had low to moderate mastery of TLE before differentiated instruction was used. According to various studies, educators are able to design the most pertinent strategies and approaches to instruction based on the most appropriate level of the learners' understanding and major knowledge gaps (Langelaan, 2024; Eikeland, 2022). The pretest results therefore provided the baseline for identifying the students' learning needs and determining the extent of improvement after the differentiated instruction intervention.

#### **3.4.2 Posttest Scores After Differentiated Instruction**

After the implementation of differentiated instruction, the respondents showed a clear improvement in achievement across all learning styles. Among visual learners, 56.7% reached the "Master" level and 16.7% reached the "Expert" level. Among auditory learners, 56.7% reached the "Master" level and 10.0% reached the "Expert" level. Among kinesthetic learners, 60.0% reached the "Expert" level and 30.0% reached the "Master" level. No respondent remained in the "Not Master" level after the intervention. The results suggest that differentiated instruction helped students move from lower mastery levels to higher performance categories. The literature states that differentiated instruction enhances academic performance because it designs and offers new learning alternatives and opportunities that meet the unique needs of different learners, thereby improving their quality and depth of engagement and understanding (Compen et al., 2025; Fitrialdi et al., 2024). The strong posttest performance of kinesthetic learners also supports the importance of hands-on, experiential, and practical approaches in TLE instruction.

#### **3.4.3 Difference Between Pretest and Posttest Scores**

The paired samples t-test showed a substantial improvement in students' performance after exposure to differentiated instruction. The pretest mean was 6.20, while the posttest mean increased to 11.23. The mean difference was -5.033, with a standard deviation of 0.964 and a standard error mean of 0.176. The computed t-value was -28.589 with 29 degrees of freedom, and the p-value was 0.000, which is lower than the 0.05 level of significance. The confidence interval ranged from -5.393 to -4.673, supporting the reliability of the difference. The result indicates that the null hypothesis stating that there is no significant difference between pretest and posttest scores is rejected. As emphasized in the literature, differentiated instruction promotes improved learning outcomes by addressing individual learner needs and fostering active engagement (Compen et al., 2025; Fitrialdi et al., 2024). The higher posttest scores suggest that students understood TLE better after instruction was matched with their learning preferences. This is the same reason as the Compen et al. (2025) study, whereby she states that students' learning outcomes are significantly improved to be positive when the teaching methodology is adapted to better suit the students. A similar result to this study is that of Fitrialdi et al. (2024), which states that diverse instruction is positively correlated to students' learning outcomes in the subject TLE. Furthermore, the study of Pozas et al. (2021) states that diverse instruction positively impacts students' academic self-concept and achievement when there is an inclusive learning environment.

### **3.5 Integrative Discussion of the Findings**

Overall, the findings show that differentiated instruction improved students' learning outcomes, life skills, career skills, and academic performance in TLE. Kinesthetic learning appeared as the most dominant learning style, while visual and auditory learning were also present among the respondents. Students demonstrated positive levels of problem-solving, critical thinking, decision-making, technical skills proficiency, entrepreneurial skills, and practical application of TLE skills. The posttest results also showed a marked increase from the pretest results, confirming improvement after the intervention. These findings support differentiated instruction as a useful approach in TLE because it responds to learner diversity and promotes active, practical, and student-centered learning. The results emphasize that students benefit when instructional strategies combine visual, auditory, and kinesthetic modalities rather than relying on a single teaching method.

In TLE, where skill performance, real-world application, and career preparation are central, differentiated instruction helps learners develop both academic mastery and essential life and career competencies.

#### 4. Conclusion & Recommendations

The study concludes that there is a statistically significant difference between the respondents' pretest and posttest scores, leading to the rejection of the null hypothesis and confirming that learning style-based differentiated instruction has a significant positive effect on students' academic performance in Technology and Livelihood Education. The findings further indicate that differentiated instruction based on students' learning styles helped improve their life skills, career skills, and overall learning outcomes in TLE.

Based on the findings and conclusion, teachers may integrate learning style-based differentiated instruction in TLE classes, especially by incorporating hands-on and experiential activities that address students' dominant kinesthetic learning preference, while also using varied strategies such as visual aids, discussions, and practical tasks to enhance problem-solving, critical thinking, and decision-making. TLE teachers may also implement activities that strengthen students' entrepreneurial, technical, and real-world application skills to support employability and self-sufficiency. School principals are encouraged to provide differentiated instruction workshops, curriculum developers may include differentiated instruction in TLE curriculum guides and learning materials, and future researchers may conduct similar studies using larger participant groups and other research methodologies to further validate the framework of differentiated instruction.

#### Compliance with ethical standards

The authors declare no conflict of interest. This study complied with recognized ethical standards for human-participant research by ensuring voluntary participation with informed consent, the right to withdraw without penalty, and strict confidentiality through anonymous, secure, and aggregated data handling. Given the focus on psychological well-being, procedures were non-invasive, and safeguards were observed to minimize discomfort, with guidance to appropriate support services when needed, and required institutional permissions were secured for instrument use and access to academic records.

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