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Optimizing pre-laboratory idle time engagement among TVET students in higher education

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Abstract
This study examined how students in Technical and Vocational Education and Training programs engage during pre-laboratory idle time, a recurring but often overlooked phase of laboratory instruction. The investigation aimed to generate empirical insights into engagement patterns and to propose the Pre-laboratory Idle-Time Engagement Survey as a pedagogical tool for structuring this period more effectively. Conducted in two Philippine state universities, the study involved thirty-five undergraduates enrolled in laboratory-intensive programs-Bachelor of Technical-Vocational Teacher Education and Bachelor of Technology and Livelihood Education. Participants completed a validated sixty-five item engagement scale measuring cognitive, behavioral, emotional, instructor presence, environmental conditions, peer influence, motivational expectations, and TVET-specific engagement. Descriptive and correlational analyses were employed to identify the relative strength and interrelationships of these dimensions. Results showed that behavioral engagement and instructor presence consistently ranked highest, highlighting the importance of structured preparation and visible teacher support. Cognitive engagement also emerged as an important dimension, whereas emotional engagement and motivational expectations showed greater variability, reflecting uneven affective and motivational readiness. Moderate correlations were observed among peer influence, environmental conditions, and core engagement dimensions, underscoring the role of both social dynamics and logistical factors. Synthesizing these findings, the Pre-laboratory Idle Time Engagement Survey was developed as a practice-oriented guide that aligns each engagement dimension with concrete instructional strategies such as peer-led tasks, motivational prompts, and guided tool preparation. By reframing idle time as a purposeful instructional phase rather than passive waiting, this study demonstrates how the Idle-Time Engagement Matrix can help educators enhance readiness, sustain motivation, and optimize student performance in competency-based laboratory learning environments.

Keywords: Student engagement, active learning, pre-laboratory idle time, engagement survey

Introduction

The pursuit of inclusive, equitable, and high-quality education is a global priority, as reflected in Sustainable Development Goal 4 (SDG 4). Beyond expanding access, SDG Target 4.3 calls for the provision of higher and technical-vocational education that equips learners with skills, knowledge, and values for lifelong learning and meaningful participation in society [1]. Achieving this vision requires more than formal classroom instruction; it demands a holistic understanding of the different phases of the learning process [2], including less visible but potentially valuable moments before formal tasks begin [3].

In Technical and Vocational Education and Training (TVET) programs, particularly in laboratory-intensive courses, pre-laboratory idle time is a common feature of instruction [4]). These intervals, often arising from rotational scheduling, equipment constraints, or delayed demonstrations, are typically regarded as logistical necessities rather than pedagogical opportunities [5]. Yet, such moments can influence how students prepare mentally, emotionally, and behaviorally for upcoming activities. Without deliberate instructional strategies, idle time may foster distraction or disengagement, undermining the readiness needed for skill-based performance [6].

In the Philippine context, TVET is positioned as a driver for workforce development and economic mobility [7]. The Commission on Higher Education (CHED) and the Technical Education and Skills Development Authority (TESDA) emphasize competency-based, outcomes-driven instruction in programs such as the Bachelor of Technical-Vocational

Teacher Education (BTVTEd) and Bachelor of Technology and Livelihood Education (BTLEd). These programs aim to produce graduates who are industry-ready, adaptable, and self-directed learners. However, instructional design has largely focused on the structured execution of tasks, with less attention paid to transitional or preparatory phases [8], despite their potential role in shaping engagement, confidence, and performance.

Student engagement, a multidimensional construct encompassing behavioral, cognitive, and emotional dimensions [9], has been widely recognized as critical to learning success [10]. Research consistently shows that engagement fosters persistence, achievement, and self-regulation, yet most investigations have concentrated on structured classroom or online environments [11]. Engagement during unstructured, pre-laboratory period remains underexplored, particularly in practice-based disciplines like TVET, where readiness is essential for safe and efficient task execution [12].

Pre-laboratory idle time in TVET offers a unique context in which engagement is largely self-initiated or socially mediated [13]. Students may review procedures, prepare tools, confer with peers, or mentally rehearse tasks. Conversely, disengagement may occur, leading to diminished task focus and slower performance onset. Understanding these patterns is essential for designing interventions that transform idle time into an active learning phase rather than a passive waiting period [14].

To address this gap, the present study moves beyond the technical details of instrument development and validation, and instead emphasizes the instructional application of engagement findings. Specifically, it introduces the Pre-laboratory Idle Time Engagement Survey (PITES), a pedagogical tool that organizes engagement dimensions into actionable teaching strategies. The PITES is defined as a practice-oriented mapping system that links cognitive, behavioral, emotional, and contextual aspects of engagement with concrete classroom techniques designed to transform idle time into structured readiness activities. By offering instructors a validated survey of strategies aligned with engagement dimensions, PITES positions idle time as a purposeful instructional phase rather than an incidental pause.

The study contributes to the broader discourse on active learning in higher education while remaining grounded in the realities of TVET instruction. It offers educators, curriculum designers, and policy-makers an evidence-based approach to structuring pre-task moments in ways that sustain engagement, promote autonomy, and enhance the overall quality of technical-vocational training.

Materials and Methods

This study adopted a quantitative descriptive design to examine engagement patterns among Technical and Vocational Education and Training (TVET) students during pre-laboratory idle time [15]. The pilot phase was intended to generate preliminary empirical insights into how students engage during this period and to identify instructional implications for structuring idle time more effectively.

Participants and Setting

A total of 35 undergraduate students enrolled in laboratory-intensive courses in two Philippine state universities participated in the study [16]. Respondents were drawn from the Bachelor of Technical-Vocational Teacher Education (BTVTEd) and Bachelor of Technology and Livelihood Education (BTLEd) programs, both aligned with the competency-based and outcomes-driven frameworks mandated by the Commission on Higher Education (CHED) and the Technical Education and Skills Development Authority (TESDA).

The participants represented diverse specializations, including Industrial Arts, Home Economics, Information and Communication Technology, and Agri-Fishery Arts. All had prior experience with laboratory-based instruction where idle time was common, often due to rotational scheduling, limited equipment availability, or delayed demonstrations [17]. Participation was voluntary, and informed consent was obtained before data collection [18].

Instrument

Engagement during pre-laboratory idle time was measured using a 65-item multidimensional scale designed for the TVET laboratory context [19]. The instrument measured eight interrelated dimensions:

- **Cognitive Engagement:** Mental rehearsal, reviewing procedures, or task planning.
- **Behavioral Engagement:** Proactive readiness behaviors such as checking tools or preparing materials.
- **Emotional Engagement:** Affective responses including motivation, interest, or anxiety.
- **Instructor Presence:** Perceptions of visibility, guidance, and support from teachers.
- **Environmental Conditions:** Evaluation of workspace organization, tool access, and physical comfort.
- **Peer Influence:** Collaborative preparation and observational learning from classmates.
- **Motivational Expectations:** Beliefs regarding the value and relevance of the laboratory task.
- **TVET-Specific Engagement:** Preparatory behaviors tied to vocational domains (e.g., calibration, recipe prep, coding setup).

Responses were recorded on a five-point Likert scale (1=Strongly Disagree, 5=Strongly Agree). For the present study, the instrument was not evaluated for full validation (reported elsewhere) but was applied to examine engagement patterns that informed the design of the PITES.

Data Collection Procedures

Data collection took place during the 2024 academic year. Students completed the paper-based survey during scheduled laboratory sessions before formal instruction began, ensuring that responses captured the context of actual idle-time conditions. The administration required approximately 25 minutes. The researchers coordinated with faculty-in-charge for access and adhered to ethical protocols regarding voluntary participation and confidentiality.

Data Analysis

Data were analyzed in three stages

- **Descriptive Statistics:** Computed means and standard deviations to determine the relative strength of each engagement dimension. Generated profiles showing which dimensions were consistently high or variable across participants.
- **Reliability Analysis:** Internal consistency for each subscale was examined using Cronbach’s alpha, with

values ≥ 0.70 considered acceptable for early-stage studies [16].

- **Correlation Analysis:** Conducted Pearson product-moment correlations to explore interrelationships among the eight dimensions. Identified associations that highlighted potential instructional levers (e.g., Instructor Presence ↔ Behavioral Engagement).

These results were subsequently used to construct the Pre-laboratory Idle Time Engagement Survey, which maps engagement dimensions to actionable teaching strategies.

Results and Discussion

The study included 35 undergraduate students from two Philippine state universities offering laboratory-intensive TVET programs. Participants represented a mix of specializations, specifically Industrial Arts, Home Economics, Information and Communication Technology, and Agri-Fishery Arts, and were primarily in their second or third year of study. Gender distribution was relatively balanced. All respondents had prior exposure to pre-laboratory idle time due to rotational scheduling, equipment constraints, or staggered groupings, ensuring that the context examined was authentic to the instructional realities of TVET settings.

Participant Profile

Most students reported frequent exposure to idle time, typically occurring before instructor-led demonstrations or while waiting for access to laboratory tools or workstations. This recurring feature underscores the importance of understanding engagement patterns in these periods. Many participants also indicated regular use of printed modules or performance sheets, consistent with CHED and TESDA's emphasis on modular and outcomes-based laboratory instruction.

Descriptive Statistics of Engagement Dimensions

Analysis of the eight engagement dimensions revealed generally moderate to high levels of self-reported engagement. Behavioral Engagement (M=4.45, SD=0.56) and Instructor Presence (M=4.38, SD=0.59) yielded the highest means, indicating that students most consistently engaged in readiness-oriented actions and responded positively to visible instructor support during idle time. Cognitive Engagement (M=4.02, SD=0.68) also recorded relatively high values, reflecting students' tendency to mentally rehearse laboratory tasks as shown in Table 1.

Table 1: Descriptive Statistics of Engagement Dimensions

Subscale	Mean	SD	Interpretation
Cognitive Engagement	4.02	0.68	High
Behavioral Engagement	4.45	0.56	Very High
Emotional Engagement	3.68	0.74	Moderate
Instructor Presence	4.38	0.59	Very High
Environmental Conditions	3.85	0.70	High
Peer Influence	3.92	0.65	High
Motivational Expectations	3.60	0.78	Moderate
TVET-Specific Engagement	4.20	0.63	High

By contrast, Emotional Engagement (M=3.68, SD=0.74) and Motivational Expectations (M=3.60, SD=0.78) showed lower means with greater variability, suggesting differences in affective readiness and perceptions of task value. Environmental Conditions and Peer Influence scored in the mid-to-high range, highlighting the impact of laboratory setup and social dynamics. TVET-Specific Engagement (M=4.20, SD=0.63) was also high, emphasizing the hands-on, practice-oriented focus of TVET learners.

Reliability Analysis

Internal consistency analysis demonstrated satisfactory to excellent reliability across the subscales, with Cronbach's alpha values ranging from 0.748 to 0.847. Table 2 illustrates the highest reliability was recorded for Behavioral Engagement (α=0.847), followed by Emotional Engagement (α=0.844) and Instructor Presence (α=0.829).

Table 2: Reliability coefficients of engagement subscales

Engagement Dimension	Cronbach's Alpha (α)	Interpretation
Cognitive Engagement	0.811	Good
Behavioral Engagement	0.847	Very Good
Emotional Engagement	0.844	Very Good
Instructor Presence	0.829	Very Good
Environmental Conditions	0.782	Acceptable
Peer Influence	0.755	Acceptable
Motivational Expectations	0.748	Acceptable
TVET-Specific Engagement	0.805	Good
Overall Engagement Scale	0.803	Good

The overall engagement scale achieved an alpha of 0.803, surpassing the commonly accepted threshold for pilot research [20].

Inter-Subscale Correlations

Pearson correlation analysis identified several notable associations among the engagement dimensions [20]. Table 3 shows a moderately strong positive correlation was observed between Behavioral Engagement and Instructor Presence (r=0.60), suggesting that students were more likely to engage proactively when instructors were visibly supportive. Cognitive Engagement and Behavioral Engagement were also closely related (r=0.69), highlighting the link between mental rehearsal and readiness behaviors.

Table 3: Correlation matrix of engagement dimensions

Subscale	Cog Eng	Beh Eng	Emo Eng	Inst Pres	Env Con	Peer Inf	Mot Exp	TVETEng
Cognitive Engagement	1.00	0.69	0.29	0.57	0.41	0.38	0.34	0.49
Behavioral Engagement	0.69	1.00	0.33	0.60	0.46	0.42	0.35	0.52
Emotional Engagement	0.29	0.33	1.00	0.31	0.25	0.27	0.30	0.28
Instructor Presence	0.57	0.60	0.31	1.00	0.43	0.39	0.36	0.45
Environmental Conditions	0.41	0.46	0.25	0.43	1.00	0.40	0.31	0.38
Peer Influence	0.38	0.42	0.27	0.39	0.40	1.00	0.33	0.37
Motivational Expectations	0.34	0.35	0.30	0.36	0.31	0.33	1.00	0.24
TVET-Specific Engagement	0.49	0.52	0.28	0.45	0.38	0.37	0.24	1.00

More modest associations were noted for Cognitive Engagement and Instructor Presence (r=0.57) and Cognitive Engagement and TVET-Specific Engagement (r=0.49), reflecting the reinforcing role of teacher visibility and domain-specific preparation. Cognitive Engagement and Motivational Expectations showed a weaker relationship (r=0.34), indicating only a limited alignment between students perceived value of tasks and their mental preparation.

Overall, correlations ranged from weak to moderate, underscoring the interplay of multiple engagement dimensions without suggesting redundancy.

Key Drivers to Student Engagement

Behavioral Engagement recorded the highest mean score among the eight dimensions, indicating that students tended to use idle time proactively for preparatory actions such as checking tools, organizing materials, and rehearsing procedures. This aligns with prior evidence that preparatory behaviors significantly enhance performance in skill-based environments [21, 22]. Equally important was the role of Instructor Presence, which also ranked highly and demonstrated a moderate positive correlation with Behavioral Engagement (r=0.60). This suggests that visible teacher involvement during idle time encouraged students to take ownership of their preparation. Previous studies have shown that teacher visibility reinforces accountability and focus [23], and within the framework of Self-Determination Theory [24], instructor presence can be interpreted as providing the structure needed to enhance perceived competence and motivation. The association, though moderate rather than strong, reinforces the idea that even informal teacher circulation and brief interactions during idle time can stimulate readiness behaviors

Variability in Student Engagement

Unlike behavioral readiness, Motivational Expectations and Emotional Engagement showed greater variability across participants, reflected in lower mean scores and weaker associations with other dimensions. Motivational Expectations displayed only a modest correlation with Cognitive Engagement (r=0.34), suggesting that while students who valued laboratory activities were somewhat more inclined to mentally prepare, perceived task value was not a consistent predictor of mental rehearsal. This finding departs from earlier assumptions that motivation and cognition are tightly coupled [25], highlighting the possibility that contextual cues such as instructor support and peer modeling may be stronger determinants during idle time.

Similarly, Emotional Engagement was only weakly correlated with other dimensions, indicating that students' affective states interest, anxiety, or enthusiasm were highly situational. Previous research confirms that emotional engagement is less stable than behavioral engagement and is strongly influenced by immediate context [26]. In laboratory-based settings, where delays or resource shortages are common, these fluctuations may be amplified [27]. From an instructional perspective, these results point to the need for intentional strategies to foster consistent motivational and emotional readiness, such as previewing outcomes, linking activities to real-world applications, or offering brief motivational prompts

Supporting Factors to Student Engagement

Although not the most dominant dimensions, Peer Influence and Environmental Conditions contributed meaningfully to idle-time engagement. Peer Influence correlated moderately with both Cognitive Engagement (r=0.38) and Behavioral Engagement (r=0.42), suggesting that students often observed and mirrored the actions of their classmates. This finding supports the notion of social modeling as a mechanism of engagement [28], reinforcing the value of collaborative or peer-led tasks even in short waiting periods.

Environmental Conditions, which correlated moderately with Behavioral Engagement (r=0.46) and Instructor Presence (r=0.43), further highlighted the importance of physical and logistical context. Well-organized workspaces, accessible materials, and reduced distractions facilitated smoother transitions into laboratory activities, while cluttered or resource-limited settings disrupted focus [6]. These findings indicate that engagement during idle time is shaped not only by individual readiness but also by the broader instructional environment

Implications for Instruction

Taken together, the results emphasize that pre-laboratory idle time can be reframed as an instructional phase rather than a passive gap. By synthesizing these patterns, the study proposes the Pre-laboratory Idle Time Engagement Survey (PITES), a practice-oriented tool that maps engagement dimensions to concrete teaching strategies. For example, high Behavioral Engagement and Instructor Presence suggest that teacher circulation combined with structured preparatory tasks can maximize readiness. Variability in Emotional Engagement and Motivational Expectations highlights the need for motivational prompts and relevance cues. Peer Influence and Environmental Conditions underscore the importance of collaborative micro-tasks and organized learning spaces.

The PITES serves as a bridge between measurement and practice, offering TVET instructors and institutions a structured approach to leverage idle time for active learning, skill reinforcement, and student readiness.

Conclusion

This study examined how TVET students engage during pre-laboratory idle time, a transitional phase that has often been overlooked in instructional planning. Findings revealed that behavioral engagement and instructor presence emerged as the most consistent indicators of readiness, while motivational expectations and emotional engagement displayed greater variability, reflecting the influence of situational and contextual factors. Peer influence and environmental conditions, though secondary, were shown to play meaningful roles in shaping preparatory behaviors and mental rehearsal. Building on these insights, the study introduces the Pre-laboratory Idle Time Engagement Survey (PITES), a pedagogical tool that organizes engagement dimensions into actionable strategies for instructional practice. The PITES demonstrates that idle time, when structured intentionally, can be leveraged to sustain attention, foster collaboration, and strengthen students' readiness for skill-based performance. By aligning engagement dimensions with targeted interventions such as motivational prompts, collaborative peer tasks, guided tool preparation, and active instructor circulation the survey provides educators with a practical guide for transforming idle moments into opportunities for active learning.

Overall, the study affirms that pre-laboratory idle time should not be regarded merely as logistical downtime but as a purposeful instructional phase that can contribute to higher levels of readiness, motivation, and performance. For TVET educators, curriculum designers, and policy-makers, the PITES offers a concrete framework for integrating engagement strategies into lesson planning, thereby enhancing the quality and effectiveness of competency-based education.

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