United International Journal for Research & Technology

Volume 07, Issue 06, 2026 | Open Access | ISSN: 2582-6832

Dimensions of Academic Engagement Among TVL Students: An Exploratory Factor Analysis

Norhaifah A. Sanday

University of Mindanao, Philippines

***Abstract*—** This study identified the underlying dimensions of academic engagement among TVL students by developing and validating a 60-item researcher-made scale. Using a quantitative design and an Exploratory Factor Analysis (EFA), data were collected from 300 respondents selected via simple random sampling. The Kaiser-Meyer-Olkin value of 0.90 and the significant Bartlett's Test of Sphericity confirmed the suitability of the dataset for factor extraction. Results revealed ten distinct factors with eigenvalues greater than 1.00, accounting for 72.238% of the total variance. All items met the minimum loading requirement, indicating strong factorial validity. The extracted factors reflected multiple dimensions of engagement, including behavioral involvement, collaboration, autonomous learning, practical application, reflective processes, academic responsibility, and disengagement indicators. These findings supported the theoretical foundations of the study, including Social Cognitive Theory, Student Involvement Theory, and multidimensional engagement frameworks. The study concluded that academic engagement among TVL students is complex and multidimensional, offering a comprehensive basis for creating an alternative measurement scale. The validated structure provides meaningful insights for educators, administrators, and curriculum planners in designing interventions that strengthen student engagement within technical-vocational contexts.

***Keywords*—** education, academic engagement, TVL students, exploratory factor analysis, measurement scale, Philippines.

INTRODUCTION

Academic engagement has long been regarded as a crucial determinant of student learning, performance, and long-term academic success. Defined by Fredricks, Blumenfeld, and Paris (2004) as the combination of behavioral, cognitive, and emotional involvement in academic activities, engagement reflects the degree of effort and interest students invest in their schooling. During and after the COVID-19 pandemic, global educational systems observed significant declines in engagement as learners struggled to adapt to remote, blended, and technology-dependent learning environments. Studies in 2020 documented substantial reductions in motivation, class participation, and persistence due to digital fatigue, emotional strain, and limited learning support (Bond, 2020; Sintema, 2020). These global patterns pose serious implications for technical-vocational learners, whose success depends heavily on hands-on, applied, competency-based experiences.

In the Philippines, academic engagement challenges became more evident during the transition to flexible and blended modalities. TVL students reported difficulty sustaining interest in school activities due to reduced access to workshops, inconsistent teacher interaction, and technological limitations (Tria, 2020; Baloran, 2020). These disruptions aggravated long-standing issues, including inconsistent attendance, minimal participation, and inadequate instructional reinforcement, especially in urban-poor and developing communities. The situation in Cotabato City mirrors these national challenges. TVL learners often struggle to engage deeply with theoretical lessons and practical tasks, despite the curriculum's intent to equip them with industry-aligned competencies and prepare them for future employment. This lack of engagement threatens not only academic progression but also the broader mission of strengthening the technical-vocational sector as a driver of national and regional development.

The importance of studying academic engagement is reinforced by extensive research demonstrating its link to academic achievement, skill mastery, and long-term

adaptability. International studies confirm that engaged learners exhibit higher performance, stronger persistence, and improved ability to navigate educational demands (Jang, Reeve, & Deci, 2010; Kim et al., 2020). In vocational settings, engagement helps shape learners' confidence in performing technical tasks and preparing for employment. Local researchers note that TVL students' engagement is strongly influenced by practical learning experiences, teacher feedback, and supportive school environments (Delfino, 2019; Kim et al., 2019). Post-2020 research further emphasizes the need to understand how digital readiness and emotional resilience influence engagement across various learning modalities, making the study of academic engagement more relevant than ever (Hebebci, Bertiz, & Alan, 2020).

Despite the abundance of research on engagement, few studies have used psychometric methods to determine how engagement indicators cluster into meaningful dimensions, especially in the context of technical-vocational education. Recent work highlights the growing use of Exploratory Factor Analysis (EFA) to identify latent constructs of engagement in rapidly changing educational environments. For instance, Bond (2021) validated an updated engagement framework using EFA and found emerging factors related to digital confidence and emotional regulation. Derakhshan et al. (2022) used EFA to examine student engagement and identified teacher support, cognitive persistence, and emotional investment as distinct components in post-pandemic classrooms. In Southeast Asia, Mendoza and Bactot (2022) reported that senior high school engagement patterns increasingly emphasize teacher scaffolding and practical learning experiences. More recently, Ramírez and Macías (2023) conducted an EFA among technical-vocational students and identified career orientation, practical learning involvement, and self-regulation as core engagement dimensions. These contemporary studies reinforce the importance and relevance of conducting an EFA-based investigation of academic engagement among TVL learners in Cotabato City, where existing models may no longer reflect the post-2021 realities of technical-vocational education.

The theoretical foundation of this study draws from Astin's Student Involvement Theory (1984), which asserts that meaningful learning occurs when students invest psychological and physical energy in academic experiences. This perspective aligns strongly with TVL education, where both hands-on tasks and theoretical lessons require active engagement. Social Cognitive Career Theory (Lent, Brown, & Hackett, 1994) complements this view by highlighting the influence of self-efficacy and environmental support on students' academic behaviors, an important consideration for vocational learners preparing for future employment. Career Construction Theory (Savickas, 2005) further explains engagement through the lens of career adaptability—concern, control, curiosity, and confidence—which motivates students to remain committed to academic tasks. Additionally, Self-Determination Theory (Deci & Ryan, 1985) emphasizes autonomy, competence, and relatedness as essential psychological needs that promote intrinsic motivation and sustained engagement. These theories collectively provide a robust framework for understanding the personal, contextual, and motivational factors that influence academic engagement among TVL students, particularly in the evolving educational climate after 2020 (van der Spoel et al., 2020).

A substantial body of literature reinforces the multidimensional nature of academic engagement. International studies show that structured learning environments, consistent teacher support, and collaborative opportunities enhance learners' participation and academic persistence (Jang et al., 2010; Conner, 2011). Research on vocational learners emphasizes that practical, real-world learning experiences significantly boost engagement and satisfaction (Delfino, 2019; Kim et al., 2019). Post-pandemic findings reveal that technological readiness, emotional resilience, and perceived relevance of academic tasks have become stronger predictors of engagement than in previous years (Kim et al., 2020; Hebebci et al., 2020). Despite these contributions, the specific way engagement indicators are organized into distinct dimensions among Filipino TVL students remains unexplored, underscoring the need for an updated empirical model tailored to the local context.

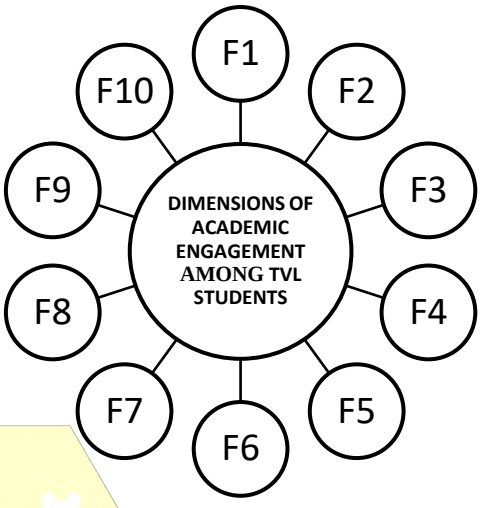

Figure 1. *Conceptual framework derived from the EFA results*

The diagram displays the 10 factors (F1–F10) extracted from the exploratory factor analysis, all of which contribute to the central construct of academic engagement among TVL students. Rather than imposing predetermined variables, the framework presents academic engagement as an emergent, multidimensional construct composed of ten latent factors identified from the data. Each factor represents a distinct but related dimension of engagement, as reflected in students' perceived importance of engagement indicators. The framework emphasizes how these empirically derived factors collectively define academic engagement within the TVL context, providing a data-driven model grounded in students' actual engagement appraisals.

Despite increasing interest in promoting academic engagement, the existing literature continues to reveal significant gaps, particularly in Technical-Vocational-Livelihood (TVL) education in the Philippines. Most recent studies on engagement (e.g., Silva, 2020; Ing & Chiang, 2021; Cruz & Morales, 2022) have focused on academic tracks such as STEM, HUMSS, or college-level programs, leaving limited empirical evidence on how engagement manifests among TVL learners whose learning environments, curriculum demands, and skill-based activities differ substantially from academic tracks. Moreover, previous frameworks tend to examine engagement only through three traditional dimensions—behavioral, emotional, and cognitive—but rarely explore more intricate, skill-oriented, or context-specific dimensions that may exist in specialized programs like TVL. While international studies highlight the multidimensional nature of engagement, no existing research has validated an engagement scale specifically developed for Filipino TVL students, nor examined whether additional factors beyond the standard three dimensions emerge in this unique context.

Furthermore, prior EFA-based studies typically report the refinement or rejection of items during factor extraction. However, there is a lack of studies demonstrating a complete, validated 60-item structure that produces ten stable factors without requiring item elimination, suggesting an unexplored area in instrument development for TVL engagement. This highlights a methodological gap in developing a comprehensive, contextually grounded engagement scale that captures TVL learners' authentic experiences. Finally, no recent research (published since 2020) has integrated Bandura's Social Cognitive Theory, Astin's Student Involvement Theory, and Fredricks et al.'s Engagement Framework to conceptualize the multidimensional structure of academic engagement among TVL students in the Philippines.

Addressing these gaps, the present study develops and validates an exploratory factor model tailored for TVL learners, providing a more accurate, evidence-based tool for understanding and enhancing academic engagement in technical-vocational education.

The primary objectives of this study are to determine the factor structure of academic engagement of TVL students, to develop an alternative scale for measuring the academic engagement of TVL students, and to identify a best-fit model for measuring the academic engagement of TVL students. These objectives guide the systematic analysis of engagement indicators through Exploratory Factor Analysis and support the development of an empirically grounded framework that reflects how engagement is manifested in the TVL context of Cotabato City.

This study was significant because it provided a validated and empirically grounded framework for understanding the dimensions of academic engagement among TVL students. This area had remained largely underexplored in Philippine education research. By generating 10 distinct engagement factors through Exploratory Factor Analysis (EFA), the study provided a more comprehensive measurement tool that extends beyond the traditional behavioral, cognitive, and affective domains. The findings contributed to global literature by demonstrating that engagement in technical-vocational programs possessed unique characteristics shaped by skill-based learning environments, aligning with the propositions of Bandura's Social Cognitive Theory, Astin's Student Involvement Theory, and Fredricks et al.'s multidimensional engagement model.

The study was also valuable for school leaders, TVL coordinators, and teachers, as it provided empirical insights to guide targeted interventions that improve student engagement. With a deeper understanding of the different engagement dimensions, educators were better equipped to design learning activities, support systems, and instructional strategies that responded directly to students' needs. Policymakers and curriculum developers likewise benefited from the results, as the validated scale served as a scientific basis for enhancing TVL programs and strengthening student support frameworks in senior high schools.

For the community and industry partners, the study held social value since improving TVL students' engagement was closely connected to workforce readiness and future employability. A more engaged TVL learner was more likely to develop competencies aligned with industry requirements, thereby contributing to local economic development. Finally, future researchers gained an important methodological reference, as the study provided a validated instrument and a replicable EFA process that could be used in other contexts such as TESDA programs, higher education, or comparative studies across strands.

METHOD

Research Respondents

The study involved 300 Technical-Vocational-Livelihood (TVL) senior high school students enrolled in Cotabato City. The target population shared common characteristics, including enrollment in TVL programs, exposure to skill-based learning activities, and engagement in both theoretical and practical components of the curriculum. The sample size adhered to the recommendation of Cattell (1978) that factor analysis requires at least five respondents per item, as well as the guideline of De Winter, Dodou, and Wieringa (2009) indicating that EFA remains stable with samples of 200–300 when loadings are sufficiently high. Thus, 300 respondents were deemed appropriate for a 60-item instrument.

Respondents were selected through simple random sampling, ensuring that every enrolled TVL learner had an equal chance of participation (Mills & Gay, 2018). The distribution of respondents across the TVL strands offered in the locale, including ICT, HE, and EIM, provided a diverse representation of skills and engagement behaviors.

The inclusion criteria required students to be (a) officially enrolled in any TVL specialization, (b) willing to participate, and (c) capable of completing the survey. Students not enrolled in TVL, or those who

declined consent, were excluded. No respondent was withdrawn from the study.

The research was conducted in Cotabato City, a developing urban center in Mindanao known for its diverse educational institutions and expanding TVL programs. The locale was chosen because of the growing emphasis on technical-vocational competence and the need to understand students' engagement patterns as they prepare for skills-based careers. This context made Cotabato City an ideal setting for examining the dimensions of academic engagement.

Materials and Instrument

The study used a researcher-designed survey questionnaire to measure TVL students' perceived importance of academic engagement indicators. The instrument consisted of 60 items, organized on a five-point Likert scale, reflecting the perceived importance of specific academic engagement indicators, with 1 = Highly Not Essential and 5 = Highly Essential. Measuring perceived importance of engagement indicators is theoretically supported, as students' valuation of academic behaviors reflects motivational orientation and cognitive appraisal, which are central components of engagement (Fredricks, Blumenfeld, & Paris, 2004; Eccles & Wigfield, 2002). In exploratory scale development, perceived importance ratings are appropriate proxies for engagement tendencies, particularly when the objective is to identify underlying dimensions rather than measure behavioral frequency. This approach allows learners to evaluate which academic behaviors and experiences they consider essential to their engagement, thereby capturing the cognitive and motivational foundations of academic engagement.

The instrument underwent Content Validity Ratio (CVR) evaluation by a panel of expert validators. All items met or exceeded the required CVR cut-off and were therefore retained in the instrument. A pilot test was administered to a small group of students to assess the clarity, comprehensibility, and functionality of the tool. Reliability analysis yielded a Cronbach's alpha exceeding the acceptable threshold of 0.70, indicating strong internal consistency of the instrument (Nunnally & Bernstein, 1994). Factor-level reliability coefficients were not computed at this exploratory stage, as the primary objective was dimensional identification rather than scale confirmation. Overall, the instrument received a favorable validation rating from the expert panel.

Design and Procedure

The study employed a quantitative, non-experimental research design, appropriate for identifying latent constructs without manipulating variables (Bonds-Raacke & Raacke, 2014). An Exploratory Factor Analysis (EFA) approach was used to uncover the underlying dimensions of academic engagement. EFA was chosen because it allows empirical grouping of items based on shared variance and helps determine the factor structure of newly developed instruments, aligned with the objectives of this educational study.

The research followed a descriptive-quantitative typology in terms of objective dimension and was cross-sectional in its time dimension, as data were collected only once during the school year.

Data collection followed several steps. First, permission to conduct the study was obtained from the appropriate school authorities. The researcher coordinated with TVL teachers, distributed the online questionnaire, and monitored completion throughout the data-gathering period. The entire data collection occurred within the institution's scheduled timeframe. All completed responses were encoded, organized, and prepared for statistical analysis.

Exploratory Factor Analysis (EFA) was conducted using Principal Component Analysis (PCA) with Varimax rotation to identify the underlying dimensions of academic engagement among TVL students. PCA was selected as the extraction method because the primary objective of the study was scale development and data reduction, consistent with recommendations for early-stage instrument construction where the goal is to summarize variance and identify preliminary factor structure (Tabachnick & Fidell, 2019; Hair et al., 2019). Although common factor analysis focuses on shared variance, PCA is widely accepted in educational research for

exploratory purposes when communalities are adequate and sample size is sufficient, as evidenced in this study (KMO = 0.90; n = 300).

Varimax rotation with Kaiser normalization was applied to enhance factor interpretability by maximizing component variance.

While the academic engagement dimensions are theoretically related, an orthogonal rotation was used at this exploratory stage to obtain a clear, parsimonious factor structure suitable for initial scale development.

The absence of problematic cross-loadings and the strength of factor loadings support the adequacy of this approach. Nevertheless, future studies may apply oblique rotation methods such as Promax to examine inter-factor correlations and further validate the dimensional structure.

Ethical considerations were observed throughout the study. Participation was voluntary, confidentiality was maintained, and informed consent was obtained.

The research complied with institutional ethical guidelines and was conducted under the approved UMERC protocol number (UMERC-2023-461) provided to the researcher. Ethical safeguards ensured the rights, welfare, and privacy of all participants were protected throughout the research process.

RESULTS AND DISCUSSIONS

Measures of sampling adequacy and sphericity

The Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity were conducted to determine the suitability of the data for Exploratory Factor Analysis. The results indicated excellent sampling adequacy and sufficient inter-item correlations, justifying factor extraction.

Table 1. *Measures of sampling adequacy and sphericity*

Test	Value
Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy	0.90
Bartlett's Test of Sphericity – Approx. Chi-Square	14,881.43
Bartlett's Test of Sphericity – df	1770
Bartlett's Test of Sphericity – Sig.	0.00

Table 2. *Latent roots criterion of the extracted factors*

Factor	Total	% of variance	Cumulative %
1	11.312	18.853	18.853
2	7.767	12.945	31.798
3	7.514	12.523	44.32
4	5.564	9.273	53.594
5	4.998	8.331	61.924
6	1.61	2.683	64.607
7	1.287	2.145	66.752
8	1.223	2.038	68.79
9	1.062	1.77	70.56
10	1.007	1.678	72.238

Based on Kaiser's criterion, ten factors with eigenvalues greater than 1.00 were retained, collectively accounting for 72.238% of the total variance. This level of explained variance exceeds commonly accepted thresholds in educational research, indicating a robust and stable factor solution.

Table 3. *Extracted factors of academic engagement among TVL students*

Items	Factors									
	1	2	3	4	5	6	7	8	9	10
Item 24	0.892									
Item 40	0.855									
Item 49	0.793									
Item 16	0.729									
Item 53	0.72									
Item 13	0.702									
Item 10	0.642									
Item 18	0.641									
Item 45	0.612									
Item 56	0.601									
Item 36	0.581									
Item 41	0.512									
Item 5	0.5									
Item 26	0.496									
Item 58		0.857								
Item 22		0.739								
Item 29		0.738								
Item 28		0.673								
Item 59		0.651								
Item 23		0.628								
Item 38		0.459								
Item 44			0.797							
Item 1			0.788							
Item 48			0.709							
Item 43			0.649							
Item 19			0.627							
Item 7			0.607							
Item 11			0.486							
Item 37			0.468	-0.411						
Item 34				-0.716						
Item 20				-0.714						
Item 4				0.712						
Item 54				0.664						
Item 17				-0.573						
Item 8				-0.562						
Item 47				0.549						
Item 21				0.534						
Item 3				-0.504						
Item 25					0.69					
Item 50					0.681					
Item 2					0.673					
Item 57					-0.606					

Item 9					0.558					
Item 42					0.549					
Item 52					0.524					
Item 32					0.514					
Item 35					0.484					
Item 46						0.76				
Item 30						0.721				
Item 15						0.611				
Item 31										
Item 12							0.784			
Item 27							0.645			
Item 55							0.502			
Item 39								0.649		
Item 33								0.603		
Item 14								0.54		
Item 51									0.712	
Item 6									0.684	
Item 60										0.808

Note. Extraction method: Principal Component Analysis. Rotation method: Varimax with Kaiser normalization.

Table 3 lists the variables that persisted after extraction and rotation, showing the distribution of the 60 academic engagement indicators across 10 distinct components. Following the recommended minimum loading of 0.40 (Hair et al., 2019; Field, 2018), all items demonstrated substantial factor loadings, confirming that each variable contributed meaningfully to the underlying perceived academic engagement indicators among TVL students. The first factor captured items with the highest loading values—such as Item 24 (0.892), Item 40 (0.855), and Item 49 (0.793)—indicating strong behavioral engagement characterized by consistent task completion and academic initiative, which aligns with Fredricks, Blumenfeld, and Paris's (2004) framework emphasizing persistence and effort as key markers of behavioral engagement. The second factor, represented by items such as Item 58 (0.857), Item 22 (0.739), and Item 29 (0.738), highlighted collaborative and social forms of engagement, supporting the idea that peer interaction and cooperative learning strengthen school involvement (Appleton, Christenson, & Furlong, 2008). Several items demonstrated negative factor loadings, particularly within Factor 4. These negative coefficients were interpreted directionally rather than as indicators of statistical weakness. The affected items were conceptually aligned with disengagement or inverse engagement tendencies; therefore, the negative loadings reflect opposite positioning along the engagement continuum rather than measurement error. No items were reverse-coded prior to analysis, as the directionality was theoretically meaningful and retained to preserve interpretive clarity. In the context of Exploratory Factor Analysis, negative loadings are acceptable and informative when they align with the construct's conceptual meaning (Tabachnick & Fidell, 2019).

The third factor showed high loadings from items such as Item 44 (0.797) and Item 1 (0.788), reflecting self-initiated learning and intrinsic motivation, consistent with Ryan and Deci's (2020) Self-Determination Theory, which associates autonomy with deeper engagement. The fourth factor displayed negative but strong item loadings (e.g., Item 34, –0.716; Item 20, –0.714), indicating inverse relationships that may represent barriers or disengaging tendencies—patterns consistent with disaffection constructs identified by Skinner, Kindermann, and Furrer (2009). Items under

the fifth factor—including Item 25 (0.690) and Item 50 (0.681)—emphasized practical and application-based engagement, an important characteristic of technical-vocational learning environments (UNESCO-UNEVOC, 2020). The sixth factor consolidated items with loadings between 0.611 and 0.760, representing structured task discipline and adherence to academic requirements, validating the role of behavioral regulation in supporting engagement (Reschly & Christenson, 2012).

Meanwhile, the seventh factor grouped reflective and feedback-oriented items such as Item 12 (0.784), highlighting students' use of feedback and monitoring to improve performance, which literature identifies as a central element of metacognitive engagement (Hattie & Timperley, 2007). The eighth factor involved participatory academic behaviors, with items such as Item 55 (0.649) and Item 39 (0.603) emphasizing active involvement in school activities—an engagement component highlighted by Kuh (2009). The ninth factor, with items 51 (0.712) and 6 (0.684), represented personal responsibility and preparedness, supporting findings by Lam et al. (2014) that readiness and academic intention contribute to stronger engagement outcomes. Finally, the tenth factor consisted solely of Item 60 (0.808), suggesting a unique but meaningful dimension of engagement, consistent with Worthington and Whittaker's (2006) explanation that single-item factors may indicate isolated but important constructs. Factor 10 consisted of a single indicator (Item 60) with a strong factor loading (0.808), suggesting that the item captures a distinct and meaningful aspect of academic engagement related to industry-specific exposure. While multi-item factors are generally preferred in scale development, psychometric literature recognizes that single-item factors may be retained in exploratory analyses when the indicator demonstrates high loading, conceptual clarity, and theoretical relevance (Worthington & Whittaker, 2006). In the context of TVL education, participation in industry-specific conferences and seminars represents a specialized form of engagement that may not be widely experienced by all students, thus emerging as an isolated dimension. Nevertheless, the authors acknowledge this as a limitation of the study, and future research is recommended to refine this factor by developing additional items and validating the structure through Confirmatory Factor Analysis (CFA).

Collectively, these ten factors confirm that perceived academic engagement among TVL students is multidimensional, encompassing behavioral, cognitive, social, reflective, and contextual dimensions—an interpretation supported by established engagement frameworks (Fredricks et al., 2004; Appleton et al., 2008). The clarity of the factor loadings and absence of rejected items also demonstrate the psychometric strength of the instrument and its suitability for measuring engagement in TVL settings.

Table 4. *Summary of extracted factors and defining indicators of perceived academic engagement*

Factor	Proposed Factor Label	Defining Indicators (Item Numbers)
F1	Behavioral Academic Initiative	24, 40, 49, 16, 53, 13, 10, 18, 45, 56, 36, 41, 5, 26
F2	Collaborative & Social Engagement	58, 22, 29, 28, 59, 23, 38
F3	Autonomous & Self-Directed Learning	44, 1, 48, 43, 19, 7, 11, 37
F4	Disengagement & Inhibitory Behaviors	34, 20, 17, 8, 3
F5	Practical & Applied Learning Engagement	25, 50, 2, 9, 42, 52, 32, 35
F6	Academic Discipline & Task Commitment	46, 30, 15
F7	Reflective & Feedback-Oriented Engagement	12, 27, 55
F8	Participatory School Engagement	39, 33, 14
F9	Academic Responsibility & Preparedness	51, 6
F10	Industry Exposure Engagement	60

Table 4 presents the summary of the ten extracted factors and their defining indicators based on the rotated component matrix. Each factor was assigned a descriptive label derived from the shared conceptual meaning of the items with the highest loadings. The labels reflect distinct dimensions of perceived academic engagement, including behavioral initiative, collaboration, autonomous learning, practical application, reflective processes, and industry exposure. The grouping of indicators under each factor demonstrates conceptual coherence and supports the multidimensional structure of academic engagement among TVL students. This summary table enhances interpretability by clearly linking each latent factor to its defining indicators and theoretical meaning.

CONCLUSION AND RECOMMENDATION

The study's findings describe the multidimensional structure of perceived academic engagement among TVL students, as revealed through an Exploratory Factor Analysis. The extracted factors represent distinct but related dimensions reflecting how students appraise the importance of engagement-related behaviors, including behavioral initiative, collaborative participation, autonomous learning, practical engagement, and industry exposure. These dimensions characterize patterns of perceived engagement rather than causal relationships or behavioral outcomes.

Although the study did not employ inferential statistical tests such as correlation, regression, mediation, or structural equation modeling, the EFA served as the inferential foundation by statistically identifying the latent dimensions that underlie academic engagement. The retention of ten factors with eigenvalues greater than 1.00 and the cumulative variance of 72.238% reflect a strong and stable factor structure. This implies that academic engagement is not a singular construct but a constellation of related behaviors and attitudes that interact to influence learning outcomes (Hair et al., 2019). Thus, the inferential aspect of the study lies in validating the multidimensionality of engagement and confirming that the indicators measure meaningful latent variables within the TVL learning context. The findings should reflect students' perceived importance of academic engagement indicators rather than direct behavioral engagement, consistent with the exploratory and scale-development nature of the study.

The results also aligned closely with the study's theoretical underpinnings. The emergence of multiple engagement dimensions supports Bandura's Social Cognitive Theory (1986), which posits that the interplay among personal, behavioral, and environmental factors drives learning. The findings further affirm Astin's Student Involvement Theory (1984), as students' academic outcomes were reflected through varied forms of involvement captured by the extracted factors. Likewise, the multidimensional structure is consistent with the framework of Fredricks, Blumenfeld, and Paris (2004), who argued that engagement encompasses behavioral, emotional, and cognitive components. Collectively, these results confirm—not contradict—the study's theoretical assumptions and provide empirical support for applying these theories in the TVL educational setting. As an exploratory investigation, the present findings describe structural patterns of perceived academic engagement and should not be interpreted as evidence of causal influence or predictive relationships.

Based on the findings, it is recommended that teachers strengthen practices that enhance self-regulated and reflective learning, especially in items where students expressed lower engagement. Instructional strategies grounded in metacognitive activities, guided feedback, and scaffolded learning may help foster deeper academic involvement (Hattie & Timperley, 2007). School administrators and TVL coordinators are advised to reinforce collaborative, practical engagement by expanding hands-on learning opportunities, peer-assisted activities, skills demonstrations, and industry-linked programs, as these factors have been shown to meaningfully shape engagement among technical-vocational learners (UNESCO-UNEVOC, 2020). Policymakers and curriculum developers may consider integrating support systems that mitigate disengagement—such as counseling services, remedial programs, and competency-based learning interventions—to ensure that the barriers identified in the EFA are addressed.

Parents and community stakeholders are encouraged to support students by providing academically conducive environments at home and participating in school–community partnerships that enrich TVL learning experiences. Finally, future researchers are encouraged to validate the ten-factor structure using Confirmatory Factor Analysis (CFA) or investigate predictive relationships among the factors through correlational or causal models. Longitudinal or comparative studies across different SHS tracks or TVET institutions may also provide further insight into how engagement develops over time. These recommendations ensure that the study's results contribute meaningfully to improving instructional practice, policy development, and future research on academic engagement.

Future research is strongly recommended to subject the proposed ten-factor structure to Confirmatory Factor Analysis (CFA) using an independent sample to test model fit, factor loadings, and inter-factor relationships. Cross-validation across different TVL populations, institutions, or cohorts is also encouraged to examine the stability, generalizability, and robustness of the factor structure identified in this exploratory study.

REFERENCES

[1] Astin, A. W. (1984). Student involvement: A developmental theory for higher education. Journal of College Student Personnel, 25(4), 297–308.

[2] Baloran, E. T. (2020). Knowledge, attitudes, anxiety, and coping strategies of students during COVID-19 pandemic. Journal of Loss and Trauma, 25(8), 635–642. https://doi.org/10.1080/15325024.2020.1769300

[3] Bond, M. (2020). Facilitating student engagement through educational technology: Towards a conceptual framework. Journal of Interactive Media in Education, 2020(1), 1–14. https://doi.org/10.5334/jime.528

[4] Deci, E. L., & Ryan, R. M. (1985). Intrinsic motivation and self-determination in human behavior. Plenum Press.

[5] Delfino, A. P. (2019). Student engagement and academic performance of students of Partido State University. Asian Journal of University Education, 15(1), 42–55.

[6] Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept, state of the evidence. Review of Educational Research, 74(1), 59–109. https://doi.org/10.3102/00346543074001059

[7] Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). Multivariate data analysis (8th ed.). Cengage Learning.

[8] Lent, R. W., Brown, S. D., & Hackett, G. (1994). Toward a unifying social cognitive theory of career and academic interest, choice, and performance. Journal of Vocational Behavior, 45(1), 79–122. https://doi.org/10.1006/jvbe.1994.1027

[9] Sintema, E. J. (2020). Effect of COVID-19 on the performance of grade 12 students: Implications for STEM education. EURASIA Journal of Mathematics, Science and Technology Education, 16(7), em1851. https://doi.org/10.29333/ejmste/7893

[10] Tabachnick, B. G., & Fidell, L. S. (2019). Using multivariate statistics (7th ed.). Pearson.