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Research Article

College Instructors' Assessment Literacy, Technological, Pedagogical and Content Knowledge (TPACK): Predictors of Students' Academic Performance and Engagement

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Abstract

In an ever-changing landscape of dynamic teaching techniques and rapidly advancing technology, college educators stand as architects of knowledge, shaping tomorrow's leaders through innovative approaches that transcend traditional teaching paradigms. This study addressed the pressing need to harmonize assessment literacy with technological, pedagogical, and content knowledge (TPACK) to foster student engagement and academic success. The study employed a correlational design, a quantitative research method, conducted across multiple colleges within a private higher education institution located in Cagayan de Oro City during the second semester of the 2023-2024 academic year. The sample size, determined using Andrew Fisher's formula, consisted of 134 students representing various academic disciplines. Descriptive statistics such as mean, standard deviation, frequency, and percentage to determine college educators' assessment literacy and Technological, Pedagogical, and Content Knowledge (TPACK) and Inferential statistics such as multiple regression were used to determine which variable predicts students' performance and engagement. The study's findings revealed that instructors have moderate assessment literacy and excel in teaching, particularly in technological and pedagogical knowledge. However, students expressed lower confidence in their instructors' content knowledge. Despite this, students demonstrated high academic performance, with many excelling and showing strong emotional engagement in their educational activities. The research underscored the critical role of instructors' technological knowledge in boosting student academic achievement, highlighting the imperative for technological proficiency in the educational sector. Students demonstrated substantial emotional investment in their learning activities, reflecting consistently high engagement levels. Furthermore, the study found that while assessment literacy, technological expertise, and pedagogical knowledge positively influence student engagement, content knowledge surprisingly detracts from it. The conclusion asserts that enhancing technological proficiency among instructors is essential for improving student performance and engagement, encouraging educators to prioritize this aspect to achieve superior educational outcomes.

Keywords: *Assessment literacy, student engagement, technological, pedagogical, and content knowledge*

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Introduction

In an era dominated by rapid technological advancements and evolving pedagogical landscapes, college instructors play a crucial role beyond conventional teaching approaches. At the heart of this paradigm shift is the pressing need to harmonize assessment literacy with technological, pedagogical, and content knowledge (TPACK) to foster student engagement and academic success. This is at the core of this transformation.

In academic circles, there has been much discourse about how creative teaching approaches can improve student performance and engagement. The TPACK framework presents the integration of assessment literacy as a critical area of focus, emphasizing its potential to transform teaching and learning processes (Smith & Becker, 2022; Haleem et al., 2022; Tseng, 2018). Connor and Shultz (2018) highlight the importance of educators' content knowledge in promoting student engagement, while researchers such as Tran and Nguyen (2015) stress the transformative power of technological knowledge in educational settings. Adams (2018) accentuates that pedagogical strategies are vital in enriching students' learning experiences, thereby positively influencing academic performance and engagement. Additionally, Zayniddinovna (2022) examines how pedagogical strategies and assessment procedures harmonize harmoniously to provide a comprehensive, successful education model. Furthermore, research by Crookes and Ziegler (2021) examines the mutually beneficial relationship between assessment procedures and pedagogical approaches, offering a comprehensive framework for successful instruction. Notwithstanding the diversity of these contributions, there is a need for a thorough comprehension of how these components work together to support student success (Evans, 2021; Williams, 2020).

Nevertheless, the general knowledge of how the combination of TPACK and assessment literacy affects student outcomes is noticeably lacking. Prior research has often focused on isolated aspects of this complex relationship, often ignoring the synergistic potential of these components when used together (Kurt, 2019; Schmidt et al., 2019). Furthermore, the body of research on the relationship between teachers' broad skill set and their impact on students' engagement and academic performance is severely lacking, as evidenced by the scarcity of empirical outcomes.

Therefore, this study aims to determine the factors that predict academic success and engagement to thoroughly evaluate educators' assessment literacy and explore their technological, pedagogical, and content knowledge. In order to improve educational outcomes, this research aims to add fresh perspectives to the body of knowledge by highlighting the significance of assessment techniques, successful teaching methods, and the complex nature of student engagement.

This study is anchored on the Constructive Alignment by Biggs (2014) and supported by the Center of Assessment (2018) and Technological Pedagogical Content Knowledge (TPACK) Theory by Koehler et.al (2006).

Constructive alignment refers to a teaching methodology in which students' intended learning outcomes are established before instruction commences. Teaching and assessment strategies are then developed to achieve those outcomes best and evaluate students' degrees of attainment (Biggs, 2014).

Similarly, constructive alignment can advance student-centered learning and guarantee that students gain the skills and knowledge required to meet their learning goals. Instead of focusing only on what teachers must teach, constructive alignment aims to ensure that students are actively engaged in the learning process and can thoroughly comprehend the subject matter (Lambert & Corrin, 2018; Warren and Robinson, 2018). The intended outcomes outline both the activity's content and the activity that students must complete to achieve the intended outcome. Setting up a conducive learning environment and evaluating student performance in relation to the desired learning outcomes are the responsibilities of the teachers.

Center of Assessment (2018) state that the Framework of Assessment Literacy offers a multidimensional and context-dependent perspective on assessment literacy. Because assessment literacy depends on context, educators must be able to use assessment in conjunction with other pedagogical skills and knowledge to be effective. Yet, assessment literacy is multifaceted because it necessitates knowledge and abilities pertaining to testing, measurement, and data utilization principles to interpret and apply assessments.

The framework is a helpful tool for the education sector to improve instruction and learning for all students while raising assessment literacy. Testing, measurement, and data literacies are the three unique skill sets that comprise assessment literacy's core.

Testing literacy involves the capability to design, administer, and interpret formal assessments such as quizzes and standardized tests. This includes a thorough understanding of test construction, validity, reliability, and fairness and the ability

to use assessment results to inform instructional decisions (Hamilton et al., 2019). Measurement literacy requires knowledge of measurement principles, the distinction between formative and summative evaluations, and the application of tools to assess student learning (Yale, 2021). Data literacy encompasses the skills to collect, analyze, and interpret data, enabling educators to make informed instructional choices, monitor progress, identify learning gaps, and effectively communicate findings to stakeholders (Innovare, 2023).

The Technological Pedagogical Content Knowledge (TPACK) Theory, proposed by Mishra and Koehler (2006), serves as the foundation for this study. It posits that effective technology integration in education necessitates a comprehensive understanding of the interplay between Technological Knowledge (TK), Pedagogical Knowledge (PK), and Content Knowledge (CK). TK involves a critical understanding and integration of digital tools to foster inclusive learning environments, as highlighted by Smith and Doe (2022). PK relates to the comprehension and application of teaching methods, with Johnson and Collins (2021) underscoring the significance of personalized, student-centered learning. CK denotes profound expertise in a specific subject area, with Thompson and Lee (2019) advocating for a dynamic approach that connects academic content to real-world contexts.

Furthermore, the study investigated these predictors of student engagement and academic performance. Student engagement encompasses various dimensions crucial for academic success, including cognitive, behavioral, and affective engagement.

Affective engagement refers to the emotional bonds students establish with their tasks and subjects, showcasing their curiosity and sense of belonging within the learning environment (Hollister et al., 2022). Behavioral engagement is evidenced through active participation, sustained effort, and perseverance in academic pursuits (Delfino, 2019). Cognitive engagement involves thorough information processing, critical thinking, and adept problem-solving skills (Barlow et al., 2020). Educators can develop effective instructional strategies that enhance student learning and success by comprehending these three dimensions.

This study aimed to deepen the understanding of assessment literacy, teacher knowledge, and student engagement in the educational process, offering new insights and practical implications for enhancing teaching and learning in higher education. Specifically, this sought to answer the following questions:

1. How do the students assess the Assessment Literacy level of their instructors in terms of:
   1.1. Testing Literacy;
   1.2. Measurement Literacy; and
   1.3. Data Literacy?
2. How do the students assess their instructors' level of knowledge in terms of:
   2.1. Technological;
   2.2. Pedagogical; and
   2.3. Content knowledge?
3. What are the students' academic performance level?
4. How do the students assess their level of engagement considering their:
   4.1. Affective engagement;
   4.2. Behavioral Engagement; and
   4.3. Cognitive Engagement?
5. Is there a significant relationship between the teachers' assessment literacy, Technological, Pedagogical, and Content Knowledge level, and students' academic performance?
6. Is there a significant relationship between the teachers' assessment literacy, Technological, Pedagogical, and Content Knowledge level, and students' engagement?

Methods

Using a quantitative-correlational design, this study explored the relationship between students' academic performance and engagement and college educators' assessment literacy, technological, pedagogical, and content knowledge (TPACK). This design was selected because it provided a thorough understanding of the phenomena under study by recognizing and evaluating patterns within numerical data and comprehending these relationships' backgrounds and underlying mechanisms.

To ensure a comprehensive understanding of the phenomenon across various educational contexts, the research was conducted across colleges in a private higher education institution in Cagayan de Oro City in the second semester of the school year 2023-2024. Respondents identified through Andrew Fisher's formula comprise 134 students. A stratified random sampling technique was utilized to choose students and guarantee a diverse representation of disciplines. This approach allows for examining the impact of educators' competencies across a spectrum of academic fields and student demographics, enhancing the generalizability of the findings.

The study made use of both standardized and researcher-made instruments. To obtain data, a researcher-made questionnaire that evaluates educators' TPACK, Cabrejas and Mendoza (2023) on Student Engagement and assessment literacy

(Malabo, 2023) were used. Some indicators were modified. Thus, the questionnaires underwent expert review and pilot testing to guarantee validity and reliability. The survey consists of items on a Likert scale, from strongly disagreed to strongly agreed. Data for the academic performance were taken from the registrar's office following research protocols and student consent.

Three different phases were involved in the research study. Preparing research instruments, gaining ethical approval, and getting participant consent are the main goals of the pre-implementation phase. Questionnaires were sent to the students via Google Forms during the Implementation Phase. Last but not least, the Post-Implementation Phase utilizes descriptive statistics to assess college educators' literacy levels, teachers' knowledge, and students' academic performance. Using exploratory factor analysis (EFA) to determine engagement factors, descriptive statistics were used to assess students' engagement. Significant relationships between teachers' literacy and students' outcomes are examined through multiple regression.

The Research Ethics Board (REB) was consulted for ethical approval to ensure the study complies with ethical guidelines. Participants received information about the study's aim, their right to withdraw at any time, and the security and anonymity precautions in place. The researcher can only access the safely stored data. To guarantee the privacy and security of participant data, all procedures adhered to the Data Privacy Act and other pertinent data protection laws.

Results and Discussions

The following section delves into the critical insights derived from the data regarding students' assessment literacy levels and the comprehensive knowledge of their instructors in technological, pedagogical, and content domains. Furthermore, it explores the intricate ways in which these elements collectively impact students' academic achievements and levels of engagement.

College Instructors' Assessment Literacy level

Table 1 presents the mean and standard deviation of the College students' rating of their instructors' assessment literacy level. It can be gleaned from the table an overall mean of 2.84 for their assessment literacy. This suggests that college instructors have a moderate degree of assessment literacy. While this indicates a strong base in understanding assessment principles and methods, it also implies room for growth in their knowledge and abilities to improve teaching and student assessment.

Table 1. Descriptive Statistics of the College Instructors' Assessment Literacy

Literacy Level	Mean	Std. Dev.	Interpretation
Testing literacy	2.95	.423	Moderate Literacy
Measurement literacy	2.83	.376	Moderate Literacy
Data literacy	2.84	.361	Moderate Literacy
Overall	**2.84**	**.387**	Moderate Literacy

Legend: 3.60 - 4.0 – High Literacy 1.80 -2.69 - Low Literacy
2.70 – 3.59 - Moderate Literacy 1.0 - 1.79 - Very Low Literacy

A closer look at the literacy types offers more specific insights. College instructors show the most proficiency in testing literacy, with a score of 2.95, still within the moderate range. This suggests they have a strong understanding of testing concepts, test types, and when to apply them. However, their measurement literacy and data literacy, with scores of 2.83 and 2.84, respectively, reveal areas for potential growth. They likely have a basic understanding of reliability, validity, scoring, and data analysis but could benefit from expanding their knowledge to utilize assessment results better and inform instruction.

This outcome supports the conclusion reached by Kuloğlu and Tutuş (2022) in their research on English teachers' levels of curriculum literacy. The data indicated that participants of both genders largely agreed with the statements on the Curriculum Literacy Scale, implying a moderate degree of curriculum literacy. The findings underscore the need for professional development to enhance college instructors' assessment literacy. Targeting measurement and data literacy could equip educators to leverage assessments more effectively and enhance student learning.

College Instructors' Level of Knowledge

The data in Table 2 reveals college students' evaluations of their instructors' technological, pedagogical, and content knowledge.

Table 2. Descriptive Statistics of the College Instructors' Knowledge

Teacher's Knowledge	Mean	Std. Deviation	Interpretation
Technological	3.81	.675	High
Pedagogical	3.87	.581	High
Content knowledge	3.36	.629	Moderate
Overall	**3.68**	**.628**	**High**

Legend: 4.51 - 5.00 - Very High 1.51 - 2.50 - Low
3.51 - 4.50 – High 1.00 - 1.50 - Very Low
2.51 - 3.50 - Moderate

The overall mean score of 3.68 signifies a high level of proficiency. Students rated their instructors highly in technological knowledge (3.81) and pedagogical knowledge (3.87), but were less assured about their content knowledge (3.36). The consistent standard deviations (.675, .581, .629,

.628) indicate a uniform distribution of responses. These findings underscore instructors' robust skills in utilizing technology and employing effective teaching methods, as evidenced by the elevated mean scores in both technological and pedagogical knowledge. The marginally higher score in pedagogical knowledge suggests that instructors may possess slightly greater expertise in educational methodologies than in technology integration.

Li et al.'s 2022 research on in-service preschool teachers' technological pedagogical content knowledge offers similar insights. The study demonstrates the usefulness of evaluating teachers' proficiency in leveraging technology and implementing effective teaching methods.

The results suggest professional development should target content knowledge, building on teachers' tech and pedagogy strengths. However, self-reporting may not reflect actual abilities, so further objective measures are needed.

Participants' Academic Performance during the 1st Semester of SY 2023-2024

An examination of student academic performance during the initial semester of the 2023-2024 academic year showcases an overall high standard of achievement. Table 3, outlining General Point Averages (GPAs), demonstrates that a substantial number of students have excelled academically.

Table 3. Descriptive Statistics of the Participants' Academic Performance in terms of General Point Average

Academic performance level	Description	Frequency	Percentage
1.00-1.25	Excellent	12	8.9
1.26-1.50	Outstanding	36	26.9
1.51-1.75	Superior	35	26.1
1.76-2.00	Very Good	26	19.4
2.01-2.25	Good	14	10.4
2.26 and above	Moderately Good	11	8.3
Total		**134**	**100.00**

Within the cohort of 134 students, 36 (26.9%) attained a GPA between 1.26 and 1.50, falling into the "Outstanding" bracket, representing the largest proportion of students. This suggests a robust level of academic performance. A further 35 students (26.1%) achieved a GPA between 1.51 and 1.75, earning a "Superior" classification. These two groups collectively account for more than 50% of participants, emphasizing the above-average performance of the majority.

Attaining the highest grades proves challenging, yet 12 students (8.9%) managed to secure GPAs between 1.00 and 1.25, placing them in the "Excellent" category. A notable proportion of students have reached the peak of academic success.

The data implies that the academic structure in place is conducive to high achievement for most students. The GPA distribution signals a successful approach to fostering academic excellence.

Participants' Level of Engagement during the 1st Semester of SY 2023-2024

Table 4 provides a comprehensive overview of student engagement metrics, revealing a predominant trend of high engagement levels across various dimensions. The mean score for affective engagement, which quantifies students' emotional involvement in their educational activities, stands at 4.40 (SD = 0.871). This metric, the highest among all categories, underscores a significant emotional investment in learning, classifying the majority of students as exhibiting "High Engagement." The low standard deviation further indicates a consistent pattern of strong affective engagement across the student body.

Table 4. Descriptive Statistics of the Participants' Engagement

Student Engagement	Mean	Std. Deviation	Interpretation
Affective engagement	4.40	.871	High Engagement
Behavioral engagement	3.91	.852	High Engagement
Cognitive engagement	4.26	.855	High Engagement
Overall	**4.19**	**.859**	High Engagement

Behavioral engagement, which measures the extent of student participation in both academic and extracurricular activities, has a mean score of 3.91 (SD = 0.852). Although marginally lower than affective engagement, this score still signifies a considerable degree of active involvement, interpreted as satisfactory engagement. This suggests that students are actively participating in various aspects of their educational experience.

Cognitive engagement, which evaluates students' intellectual commitment to their studies, also shows elevated levels with a mean score of 4.26 (SD = 0.855). This high score reflects a strong dedication to comprehending and mastering academic material, similarly categorized under "Engagement." The close alignment of mean scores for affective and cognitive engagement illustrates a balanced and robust engagement profile among students, highlighting a well-rounded commitment to their educational pursuits.

McCormick (2019) posits that affective engagement is a pivotal component of student engagement, primarily due to its strong correlation with enhanced behavioral and cognitive involvement—both essential for academic success. This assertion implies that participants demonstrate a significant level of emotional investment and interest in the subjects or activities they are engaged in, which in turn fosters increased participation and intellectual dedication.

Significant relationship between the Instructors' Level of Assessment Literacy, Technological, Pedagogical, and Content Knowledge and students' academic performance

The regression model in Table 5 explained approximately 19.75% of the variance in academic performance ($R^2 = 0.198$). The intercept was not statistically significant, showing a coefficient of -0.6226 with a p-value of 0.6209. Regarding predictor variables, assessment literacy demonstrated a significant positive association with academic performance (coefficient = 0.6421, p = 0.0001). Technological knowledge also had a significant positive relationship (coefficient = 0.3899, p = 0.0276). Pedagogical knowledge, although having a positive coefficient (0.1993), was not statistically significant (p = 0.2555), and content knowledge showed no significant positive relationship (coefficient = 0.3799, p = 0.0576).

Table 5. Regression Analysis between the Instructors' Assessment Literacy, TPACK and Students' Academic Performance

Predictor Variable	Coefficient	Standard Error	t-value	p-value
Constant	-0.6226	0.3107	-2.003	0.6209
Assessment Literacy	0.6421	0.1553	4.134	0.0001
Technological Knowledge	0.3899	0.1743	2.237	0.0276
Pedagogical Knowledge	0.1993	0.1748	1.14	0.2555
Content Knowledge	0.3799	0.1950	1.947	0.0576

These findings indicate that specific knowledge areas of college instructors are significant predictors of students' academic performance. Notably, assessment literacy and technological knowledge emerged as significant predictors, implying that higher levels of these competencies among instructors are linked to improved academic performance in students. Assessment literacy, with its strong positive coefficient of 0.6421, suggests a substantial improvement in students' GPA with increased instructor proficiency in this area.

Similarly, technological knowledge positively impacts academic performance, as indicated by a coefficient of 0.3899, emphasizing the critical role of technological proficiency in enhancing student outcomes. Although pedagogical knowledge was not statistically significant, it still indicated a positive relationship, suggesting potential benefits from improving pedagogical skills. Content knowledge, being not significant, highlights the importance of subject matter expertise in contributing to student success. These results underscore the need for comprehensive professional development for instructors, emphasizing not only pedagogical skills but also technological proficiency and assessment literacy to enhance student academic performance.

Significant relationship between the Instructors' Level of Assessment Literacy, Technological, Pedagogical, and Content Knowledge and Student Engagement

The data from the regression analysis in table 6 shows the relationship between the teachers' level of Technological, Pedagogical, and Content Knowledge (TPACK) and students' academic performance, as indicated by their grades. This analysis uses predictors labeled as CP, PK, and TK, representing different components of TPACK.

Table 6. Regression Analysis between the Teachers' Level of Technological, Pedagogical and Content Knowledge and students' academic performance

Predictor	Coefficient	Std. Error	t-value	p-value
Assessment Literacy	0. 4080	0.1496	2.7275	0.0076
Technological Knowledge	0.2228	0.0828	2.6912	0.0084
Pedagogical Knowledge	0.7337	0.0889	8.2497	8.9376
Content Knowledge	-0.4154	0.0763	-5.4447	4.0573

Table 6 exhibits the multiple regression analysis sought to elucidate the impact of college instructors' assessment literacy, technological knowledge, pedagogical knowledge, and content knowledge on student engagement.

The results revealed that assessment literacy (coefficient = 0.408079, p = 0.008), technological knowledge (coefficient = 0.222876, p = 0.008), and pedagogical knowledge (coefficient = 0.733776, $p < 0.001$) significantly and positively influenced student engagement. Conversely, content knowledge (coefficient = -0.415491, $p < 0.001$) had a significant negative effect on engagement.

These findings underscore the critical role of pedagogical skills and technological literacy in enhancing student engagement, indicating that instructors proficient in these areas tend to engage students more effectively. However, the negative correlation between content knowledge and student engagement suggests potential issues in content delivery, necessitating further investigation to improve instructional strategies. A deeper understanding of these dynamics could lead to a balanced approach, integrating content expertise with effective teaching practices for optimal student engagement.

Similar findings were found by Holvio (2022) in Mozambique and Shepherd (2015) in South Africa who found that teacher content knowledge had a statistically insignificant effect on student achievement.

Conclusions

This study substantiates the theoretical underpinnings of Biggs' Constructive Alignment (2014), Center of Assessment (2018), and Mishra and Koehler's Technological Pedagogical Content Knowledge (TPACK) Theory (2006). It demonstrates the critical role of assessment literacy, technological expertise, and pedagogical skills in enhancing student engagement, highlighting the necessity of aligning teaching and assessment strategies with learning outcomes, as advocated by Constructive Alignment. High student ratings in technological and pedagogical knowledge, along with their significant impact on engagement, corroborate TPACK's premise that integrating technology with pedagogy augments educational outcomes.

On the contrary, the observed negative effect of content knowledge on engagement implies that subject matter expertise alone does not suffice to foster student engagement. This underscores the need for educators to strike a balance between content delivery and the application of effective pedagogical strategies and assessment literacy to sustain high levels of student engagement.

The study underscores the necessity for institutions to provide professional development for college educators to enhance their measurement and data literacy skills, including workshops on assessment interpretation, data-driven instruction, and aligning assessments with learning goals. Partnerships with assessment experts or peer mentoring could also be beneficial. Future research should investigate additional factors influencing student success and engagement, such as teaching approaches, curriculum design, student motivation, and learning environment, to achieve a holistic understanding of student outcome determinants.

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