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Factors Affecting Academic Performance of Students in Contemporary Mathematics

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Abstract
This study investigated the factors affecting the academic performance of students in Contemporary Mathematics at the College of Industrial Technology, Central Bicol State University of Agriculture-Sipocot Campus, during the school year 2023–2024. Using descriptive-comparative and Research and Development (R&D) methods, the research examined perceived cognitive, affective, and psychomotor factors, student performance across four key mathematical areas, and the predictive relationships between these variables to inform the development of Learning Activity Worksheets (LAWs). Results indicated that while all three factors were perceived as "Highly Affected" and overall student performance was "Good," only the affective factors showed a significant relationship and influence on performance; conversely, the cognitive factor did not demonstrate a significant predictive nature. Based on these empirical findings, the developed LAWs were subjected to expert evaluation for face, content, and construct validity, ultimately attaining a "Very Highly Valid" (VHV) rating. These results strongly suggest that success in Contemporary Mathematics is primarily driven by affective engagement, and the validated LAWs serve as an empirically supported tool to enhance student performance by reinforcing these practical dimensions of learning.

Keywords: Factors Affecting Academic Performance, Contemporary Mathematics, Learning Activity Worksheets

Introduction

Mathematics holds a crucial position in contemporary education, yet it remains a challenging subject for many students globally. Despite its widespread significance, students often struggle to comprehend various mathematical topics and concepts. The relevance of mathematics in real-world applications, employment prospects, and academic pursuits underscores the critical need for students to master its fundamentals. Among college undergraduates, struggles with mathematics are widespread, hindering academic progress and overall performance, with many commencing their tertiary education lacking essential mathematical foundations. These difficulties often lead to challenges in grasping more complex concepts and managing time constraints across diverse mathematical areas.

Differences in proficiency levels often translate into disparate academic achievements. Central to this success is Mathematical Proficiency, which is situated in the way an individual uses conceptual mathematical knowledge and abilities in a variety of social contexts (Umbara & Suryadi, 2019). It includes reasoning mathematically and using mathematical concepts, procedures, facts, and tools to describe,

explain, and predict phenomena (OECD, 2017). As noted by Ojose (2011), mathematical proficiency involves more than executing procedures; it requires competence and self-reliance in applying base knowledge to the practical world. Consequently, this multi-faceted proficiency forms the standard for collegiate success, demanding that students bridge the gap between classroom theory and real-world application.

However, most students find difficulty in achieving this level of proficiency. Statistics show that a significant percentage of students make errors in solving higher-level tasks, placing many in a low category of proficiency (Setiawan et al., 2020; Sari & Wijaya, 2017). Phonapichat et al. (2014) observed that students face significant hurdles in translating complex problems into mathematical sentences, while Cole (2022) points to specific learning difficulties like dyscalculia as barriers to basic concept mastery. Cognitive factors encompass students' inherent abilities and logical thinking, as highlighted by Piaget's work on cognitive development (Rabillas et al., 2024). Affective factors, including motivation, self-efficacy, and mathematics anxiety, act as significant mediators of performance (Alpacion et al., 2014; Bhowmick et al., 2017). Furthermore, psychomotor factors play a role in the manipulation of mathematical tools and the physical act of problem-solving. Recent local research by Oclarit et al. (2025) observes that grade-related concerns remain a prevalent source of anxiety among Filipino non-mathematics majors, reinforcing the need to address these intersecting paths to ensure quality education as articulated in Sustainable Development Goal (SDG) 4.

In the Philippines, the challenge of mathematics education is particularly pronounced. Research has identified student-related influences, such as learning styles and anxieties, alongside environmental and school-related factors (Acharya, 2017; Capuno et al., 2019). The legal framework supporting this emphasis on quality education includes CHED Memorandum Order (CMO) No. 12, s. 2015, which mandates continuous improvement in learning outcomes, and CMO No. 20, s. 2013, which classifies Contemporary Mathematics as a core General Education subject. Despite these mandates, industrial technology students often enter tertiary education with inconsistent foundations, resulting in a "vocational math gap" (Guinocor et al., 2020; Khavenson et al., 2023). To bridge this gap, instructional design models like ADDIE and specialized Learning Activity Worksheets (LAWs) have become essential (Molenda, 2015; Lacsa, 2022).

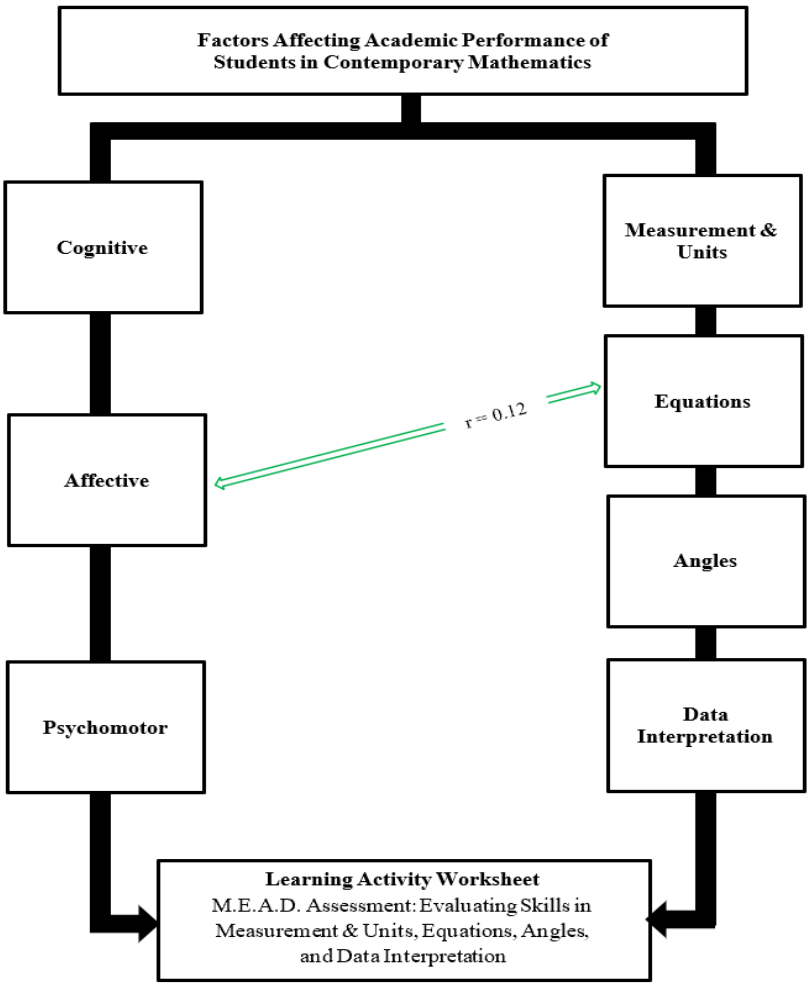
Within this context, the present study specifically determined how cognitive, affective, and psychomotor factors influenced the academic performance of second-year BSIT students at the College of Industrial Technology, CBSUA-Sipocot Campus, during the second semester of the academic year 2023–2024. The research sought to assess student proficiency across four key domains: Measurement and Units, Equations, Angles, and Data Interpretation. Furthermore, the study aimed to determine the significant relationship between these influencing factors and the measured level of performance, serving as the empirical basis for the development and validation of the M.E.A.D. Learning Activity Worksheets. The study proceeded under the assumption that these factors and levels of performance could be accurately measured through specific parameters and validated research instruments. It was hypothesized that a significant relationship exists between the identified cognitive, affective, and psychomotor factors and the students' level of performance in Contemporary Mathematics. By focusing on selected learning competencies for the BSIT program, this research addresses the remaining gap in understanding course-specific difficulties, ensuring that students develop the mathematical foundation essential for their future professional success.

Theoretical and Conceptual Framework

The study is theoretically grounded in the intersection of cognitive and affective learning theories. Piaget's Theory of Cognitive Development serves as the primary anchor, emphasizing that mathematical understanding evolves through logical-mathematical construction (Rabillas et al., 2024). This is supported by Tomkins' Affect Theory (1962), which posits that the affective system is the primary motivational mechanism of human behavior. Tomkins' theory suggests that emotional states act as amplifiers that either facilitate or inhibit cognitive persistence and performance. This is further complemented by the Affective Domain Theory, which recognizes that motivation and anxiety levels act as critical mediators in the learning process (Chizhikova, 2021). To address these factors, the study utilizes the ADDIE Model: Analysis, Design, Development, Implementation, and Evaluation as the structural basis for creating the M.E.A.D. Learning Activity Worksheets (Molenda, 2015).

As illustrated in the conceptual framework (Figure 1), the study examines the influence of independent variables Cognitive, Affective, and Psychomotor factors on the dependent variable, which is the Academic Performance of BSIT students in Contemporary Mathematics. The performance is assessed across specific domains: Measurement and Units, Equations, Angles, and Data Interpretation. The relationship between these variables provides the empirical basis for the development of the M.E.A.D. worksheets, which aim to bridge the "vocational math gap" identified in the literature.

Figure 1. Conceptual Paradigm



Methodology

A descriptive-correlational research design combined with a Research and Development (R&D) method was employed to assess the cognitive, affective, and psychomotor factors affecting student performance in Contemporary Mathematics, as well as the relationships among these variables. The respondents consisted of 305 second-year Bachelor of Science in Industrial Technology (BSIT) students at the Central Bicol State University of Agriculture-Sipocot Campus, selected through stratified random sampling. Based on the findings, the study utilized a Modified ADDIE Model to develop Learning Activity Worksheets (LAWs) designed to address identified performance gaps in specific mathematical domains.

Data were collected using researcher-made instruments, primarily the M.E.A.D. Assessment (Measurement, Equations, Angles, and Data Interpretation) and a factor-perception questionnaire, both validated by an expert panel in mathematics education and research methodology. The instruments achieved a "Very Highly Valid" (VHV) rating, and reliability was established through pilot testing using the Kuder-Richardson 21 formula. Responses were analyzed using weighted mean, Pearson product–moment correlation coefficient, and the coefficient of determination to identify significant predictors of academic success. Ethical standards were strictly observed, including the transparent disclosure of AI tools for literature synthesis, informed consent, and the confidentiality of student data.

Results and Discussion

This section presents the data derived from the validated survey instruments and the M.E.A.D. Assessment administered to the second-year BSIT students of CBSUA-Sipocot. The findings are organized according to the study's specific objectives, with each table followed by a detailed examination of the results. The discussion integrates interpretation, conclusions, and alignment with existing literature to provide a comprehensive understanding of the relationships among cognitive, affective, and psychomotor factors and academic performance in Contemporary Mathematics.

The students demonstrated a "High" perception of affective factors, indicating that their emotional engagement, attitude toward the subject, and mathematical self-efficacy are significant drivers of their learning process. This level of engagement suggests that students are more likely to persevere through complex problem-solving tasks when they perceive the subject as relevant and attainable, thereby reinforcing the statistical link between affective domains and actual performance levels. These findings align with the Theory of Performance, which posits that psychological state directly modulates the execution of cognitive tasks in technical education.

Factors Affecting Academic Performance

The factors affecting academic performance were described in this study. In other cases, academic performance is a complex outcome influenced by a mix of student abilities, motivation and effort, teacher quality, family support, and the overall school environment. Thus, in this study, it was used to determine the factors which affect students' performance in mathematics along with cognitive, affective, and psychomotor. The weighted mean, means, standard deviation, and performance levels were computed to determine the classification where there were in the right place.

The study revealed that among the primary factors, the psychomotor factor obtained the highest rating with an Average Weighted Mean (AWM) of 2.86, followed by the cognitive factor (AWM=2.83) and the affective factor (AWM=2.75), all of which were interpreted as "Highly Affected." This hierarchical ranking suggests that students in this technical environment are predominantly action-oriented learners

whose academic output is most significantly influenced by their physical and procedural engagement with mathematical tasks rather than theoretical absorption. The overall grand mean of 2.81 indicates that students perceive their performance as a multifactorial result heavily weighted toward active learning and tactile stimulation. These findings align with Steen's (2001) Theory of Quantitative Literacy, which posits that mathematical success in the modern age requires practical, contextual skills embedded in action and further support the development of instructional interventions like Learning Activity Worksheets (LAWs) to provide the procedural scaffolding necessary to address these high psychomotor and cognitive needs.

Table 2: Overall Factors Affecting the Academic Performance of the Students

Factors	**Average Weighted Mean**	**Interpretation**
Psychomotor	2.86	HA
Cognitive	2.83	HA
Affective	2.75	HA
Overall Average Weighted Mean	2.81	HA

Note. Range Interpretation: 3.26-4.00 Very Highly Affected (VHA), 2.51-3.25 Highly Affected (HA), 1.76-2.50 Moderately Affected (MA), and 1.00-1.75, Fairly Affected (FA).

Students' Level of Performance in Contemporary Mathematics

The M.E.A.D. Assessment results revealed an overall performance level of 82.55, interpreted as "Good," with students demonstrating their highest proficiency in Data Interpretation (PL=84.6) and Measurement and Units (PL=83.7). These "Satisfactory" ratings suggest that BSIT students are more successful when mathematical tasks are tied to physical reality and direct environmental interaction, aligning with Piaget's Constructivism and the "Concrete Operational Stage" of cognitive development. Conversely, the Angles domain recorded the lowest performance level of 79.8, interpreted as "Fair," highlighting a significant struggle with higher-order thinking skills and abstract spatial reasoning. This performance gap confirms the findings of Kaur (2020) regarding spatial disorientation in technical students and serves as the primary empirical justification for the Analysis phase of the Modified ADDIE Model, leading to the development of the M.E.A.D. Learning Activity Worksheets to provide the necessary visual and procedural scaffolding for geometric mastery.

Table 3: Students' Level of Performance in Contemporary Mathematics

Indicators	**No. of Items**	**M**	**SD**		**PL**	**Interpretation**
Measurement & Units	10	8.37	1.42	LS	83.7	Satisfactory
Equations	10	8.22	1.57	LS	82.2	Good
Angles	10	7.98	1.72	LS	79.8	Fair
Data Interpretation	10	8.46	1.34	LS	84.6	Satisfactory
Overall	40	33.02	1.51	LS	82.55	Good

Note. Range Interpretation: 98-100 Excellent, 95-97 Highly Outstanding, 92-94 Outstanding, 89-91 Very Satisfactory, 86-88 Very Good, 83-85 Satisfactory, 80-82 Good, 77-79 Fair, 75-76 Passing, 71-74

Conditional, Incomplete, and 70 Failed. When SD≥3 it is Scattered or Heterogenous, and when it is SD≤3, it is Less Scattered or Homogenous.

Relationship Between the Academic Performance and Level of Performance in Contemporary Mathematics

Analysis of the relationship between perceived factors and academic performance reveals that the Affective Factor and Equations yielded the only statistically significant correlation, with an r-value of 0.12 and a p-value of 0.029 ($p<0.05$). This finding suggests that emotional states, such as interest and persistence, specifically influence performance in algebraic domains which require sustained procedural focus. As noted by Rozgonjuk et al. (2020), algebraic tasks are uniquely susceptible to "affective interference" because they demand higher working memory that can be easily depleted by anxiety or low motivation.

The significant relationship found between affective factors and student performance in equations and data interpretation aligns with the core tenets of Tomkins' Affect Theory (1962). According to Tomkins, the affective system is the 'primary blueprint' for motivation. This explains why students who reported high levels of math anxiety or low self-efficacy struggled with complex tasks; their negative affective responses acted as a psychological 'noise' that interfered with the cognitive processing required for mathematical reasoning.

Although the coefficient of determination (r^2=0.0144) indicates that the affective domain explains only 1.44% of the variance, Zafar et al. (2024) argue that even small variances are critical in educational research for identifying specific entry points for intervention. Conversely, the non-significance of cognitive and psychomotor correlations across other domains suggests a homogenous baseline of skills among the cohort, making non-cognitive traits like interest the ultimate differentiator in performance. These results align with Tomkins' Affect Theory, reinforcing the perspective that interest-excitement serves as a primary motivator for learning, and justify the development of M.E.A.D. Learning Activity Worksheets to bridge the gap between student perception and actual mathematical execution through affectively supportive instructional design.

Table 4: Relationship Between Factors Affecting the Academic Performance of the Students and Level of Performance in Contemporary Mathematics

Factors Affecting the Academic Performance	Level of Performance	r-value	Int.	p-value	Int.
Cognitive	Measurement & Units	-0.04	Very Low	0.47	NS
	Equations	0.11	Very Low	0.05	NS
	Angles	0.08	Very Low	0.15	NS
	Data Interpretation	-0.05	Very Low	0.38	NS
Affective	Measurement & Units	-0.08	Very Low	0.17	NS
	Equations	0.12	Very Low	0.029	Significant
	Angles	0.05	Very Low	0.34	NS
	Data Interpretation	-0.06	Very Low	0.26	NS
Psychomotor	Measurement & Units	-0.06	Very Low	0.29	NS

	Equations	-0.04	Very Low	0.44	NS
	Angles	-0.07	Very Low	0.24	NS
	Data Interpretation	-0.05	Very Low	0.42	NS

Note. NC = No Correlation; NS=Not Significant. r-value: Degree of Correlation - Less than ±0.20=Very Low Correlation; ±0.20 to ±0.39=Low Correlation; ±0.40 to ±0.69 = Moderate Correlation; ±0.70 to ±0.89=High Correlation; ±0.90 to ±1.00=Very High (Perfect) Correlation. p-value: ≥ 0.05=Not Significant; <0.05=Significant.

Development of Learning Activity Worksheet

The development of the specialized instructional tool was a research-driven process following a Modified ADDIE Model (Analysis, Design, Development, Implementation, and Evaluation) to address the specific performance gaps identified in the M.E.A.D. Assessment. The Analysis phase was grounded in the empirical finding that affective factors significantly influence performance in equations (r=0.12), while identifying a critical "Fair" performance level in the Angles domain (PL=79.8). This data-driven approach is supported by Adeoye et al. (2023), who assert that the success of instructional design depends on the precision of identifying performance gaps before development begins.

In the Design phase, the worksheets were structured with procedural scaffolding and motivational elements, achieving a "Very Highly Valid" (VHV) status from an expert panel across face, content, and construct validity. Specific benchmarks, such as the stimulation of Higher-Order Thinking Skills (HOTS), achieved a perfect weighted mean of 4.00, ensuring the material provides the balance of challenge and support recommended by Trisnowati (2019).

Figure 3. The M.E.A.D. Instructional Development Framework based on the Modified ADDIE Model

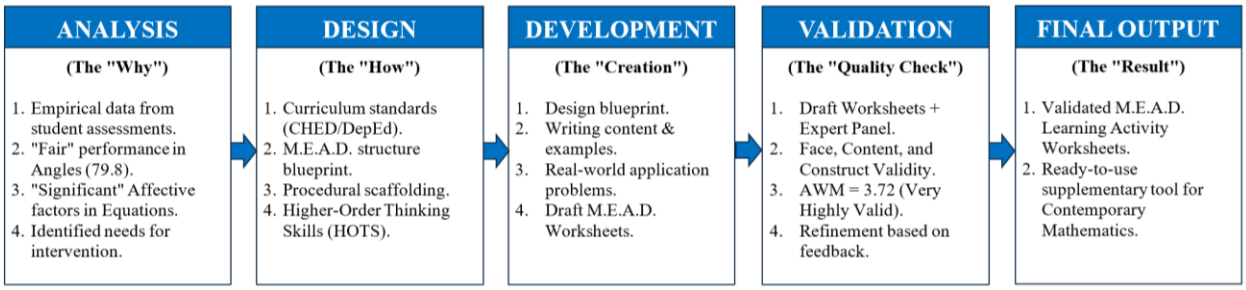


Table 5: Expert Validation of the M.E.A.D. Learning Activity Worksheets

Face Validity	**RESPONDENTS**						
Indicators	**1**	**2**	**3**	**4**	**5**	**TOTAL**	**Weighted Mean**
The learning activities provided are clear, simple, and concise.	4	4	4	4	4	20	4.00
The language is plain, uncomplicated, and easy to comprehend.	4	4	4	3	4	19	3.80
The content is appropriate for the student's cognitive and understanding level.	4	4	3	4	4	19	3.80

The activities of each concept are systematically organized.	4	3	4	3	4	18	3.60
The Learning Activity Worksheets' format, style, and visuals demand that proper grammar be followed.	3	4	3	3	3	16	3.20
Total	**3.8**	**3.8**	**3.6**	**3.4**	**3.8**	**18.4**	**3.68**

Construct Validity	**RESPONDENTS**						
Indicators	**1**	**2**	**3**	**4**	**5**	**TOTAL**	**Weighted Mean**
The learning activities are tailored to the comprehension level of the students.	4	4	4	4	4	20	4.00
The higher order thinking skills are stimulated by the learning activities.	4	3	4	4	4	19	3.80
The Learning Activity Worksheets provide sufficient learning information on the topic being discussed.	4	3	4	4	4	19	3.80
The Learning Activity Worksheets allow for development and improvement of mathematical abilities.	4	4	3	4	4	19	3.80
The Learning Activity Worksheets encourage students to be active participants in learning activities.	3	3	4	3	4	17	3.40
Total	**3.8**	**3.4**	**3.8**	**3.8**	**4**	**18.8**	**3.76**

Content Validity	**RESPONDENTS**						
Indicators	**1**	**2**	**3**	**4**	**5**	**TOTAL**	**Weighted Mean**
The Learning Activity Worksheets covers the topic contained in the Learning Competencies.	4	4	4	4	4	20	4.00
The Expected Learning Outcomes are stated.	4	4	4	4	4	20	4.00
The topics provided in the Learning Activity Worksheets contain enough information.	3	4	3	4	4	18	3.60
The Learning Activity Worksheets offer a variety of learning activities that will enrich pupils' level of competency.	4	3	3	4	4	18	3.60
The activities, discussions, and assessments are suitable for the intended learners.	4	3	4	2	4	17	3.40
Total	**3.8**	**3.6**	**3.6**	**3.6**	**4**	**18.6**	**3.72**

The final Development phase incorporated iterative refinements based on expert feedback to ensure content accuracy and pedagogical soundness, resulting in an overall validation mean of 3.72. As noted by Kozma (2023) and Hofileña and Bearneza (2023), such meticulously validated Learning Activity Worksheets (LAS) are significantly more effective at sustaining engagement in technical courses than generic exercises, providing a ready-to-use tool strategically focused on enhancing academic performance in Contemporary Mathematics.

Conclusions

This study concludes that affective, cognitive, and psychomotor factors play a distinct and measurable role in shaping the academic performance of students in Contemporary Mathematics. The "High" levels of perception toward these domains indicate that student success in technical education is supported by a significant emotional and physical readiness. While the individual effects of these factors may appear minimal in isolated statistical terms, their collective presence ensures that mathematical tasks are approached with a foundational level of engagement, reinforcing the idea that achievement is a complex result of student disposition and procedural capability.

The study further establishes that students demonstrate a consistent and satisfactory level of general mathematical performance; however, clear gaps in mastery are evident in domains requiring abstract reasoning and spatial visualization, such as Angles. This specific proficiency gap underscores the transition from rote, concrete calculation to higher-order thinking as a critical barrier for Industrial Technology students. Consequently, performance in geometry emerged as a significant area of concern, confirming that without targeted visual and procedural interventions, students struggle to translate basic knowledge into the spatial reasoning required for technical mastery.

Furthermore, the significant relationship identified between the affective factor and
equations indicates that tenure in procedural problem-solving is strengthened when technical skill is paired with emotional persistence. The findings confirm that algebraic success is not merely a function of cognitive ability but is shaped by how well a student manages mathematical anxiety and maintains interest-excitement. When students feel a high sense of self-efficacy, they demonstrate greater focus and a reduced risk of "affective interference" during multi-step calculations, leading to more accurate and consistent mathematical outputs.

Overall, the study affirms that academic performance in Contemporary Mathematics is a practical outcome of competent procedural skills, emotional readiness, and high-quality instructional support. The successful development and expert validation of the M.E.A.D. Learning Activity Worksheets provide empirical evidence that addressing student needs through the Modified ADDIE Model can effectively bridge performance gaps. Strengthening cognitive skills in isolation is insufficient; rather, academic success is reinforced through an integrated approach that acknowledges the student as an active, affect-driven learner in a technical environment.

Recommendations

Based on the findings and conclusions of the study, several recommendations are proposed to further enhance student performance in Contemporary Mathematics through pedagogical and institutional improvements.

First, mathematics instructors should transition from traditional lectures to an active-learning classroom environment to address the high influence of psychomotor, cognitive, and affective factors. Lessons

should incorporate procedural tasks that engage students physically and emotionally, such as hands-on measurement activities, to satisfy the psychomotor needs identified in the study. Additionally, periodic self-reflection surveys should be institutionalized to monitor student anxiety levels, ensuring that the affective domain is supported through positive reinforcement and a low-stress learning atmosphere.

Second, based on the performance gaps across domains, immediate instructional intervention is recommended for the topic of Angles. Instructors should implement specialized remedial sessions utilizing spatial reasoning workshops and 3D modeling tools to help students bridge the gap between concrete calculation and abstract geometric visualization. To sustain the satisfactory performance observed in Data Interpretation and Measurement, teachers should continue integrating real-world datasets that allow students to apply mathematical concepts to practical, everyday scenarios.

Third, the academic department should implement motivation-centered lessons for algebraic units, given the significant relationship found between the affective factor and success in solving equations. Instructors should design modules that prioritize building student self-efficacy and focus on interest-excitement triggers. By using real-life application problems, educators can reduce math anxiety and encourage the emotional persistence required for multi-step problem solving. This holistic approach ensures that performance is bolstered by the student's emotional engagement rather than cognitive ability alone.

Fourth, the university should officially adopt the M.E.A.D. Learning Activity Worksheets as a core supplementary resource to provide a standardized, systematic framework for student practice. To ensure the long-term effectiveness of these materials, the academic head should establish a feedback loop were instructors report on student engagement with specific modules. This allows for iterative improvements grounded in the ADDIE model of instructional design, ensuring the worksheets serve as reliable formative assessment tools and structured review materials.

Finally, future studies are encouraged to expand the scope of inquiry by conducting longitudinal experimental research to measure the actual impact of the M.E.A.D. worksheets on student retention over time. Comparative studies involving other technical courses or different institutional settings may further validate the causal pathways between instructional design and academic achievement, contributing to more robust evidence-based mathematical curricula in technical education.

Through the implementation of these recommendations, academic institutions can enhance the effectiveness of mathematics instruction, empower students to overcome affective barriers, and promote a more equitable and successful learning environment for industrial technology learners.

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