

PAPER

Examining the Correlation between Mathematical Resilience, Achievement Goals, and Mathematics Performance of Engineering Students

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Colleges, Philippinesharoldterano@cspc.edu.ph**ABSTRACT**

This paper explores the relationship between mathematical resilience, achievement goals, and mathematics performance among engineering students. This study utilized 287 responses from the 945 students in the various engineering programs at Camarines Sur Polytechnic Colleges, Philippines. Questionnaires were adopted from the Mathematics Resilience Scale (MRS) and Achievement Goal Questionnaire-Revised (AGQ-R). The results show varying levels of performance. The study reveals a negative correlation between mathematics performance and resiliency, along with value and struggle. Likewise, there is a positive correlation between academic performance and mathematical resiliency related to growth, indicating that students who believe in their ability to improve will achieve better results and academic success. Findings also reveal that there is no significant correlation between academic performance and achievement goals. These results suggest that these goals shape attitudes but do not directly affect mathematics performance. Based on the findings of the study, there is a need for policies to enhance engineering students' mathematics resilience in the institution. Relevant educational policies may be crafted, including but not limited to integrating growth mindset principles into the curriculum, promoting mentorship programs for struggling students, and prioritizing resilience and emotional well-being, thereby enhancing academic performance and the overall learning experience.

KEYWORDS

mathematical resilience, achievement goals, mathematics performance, correlation study, engineering students

1 INTRODUCTION

Engineering is a field of discipline that uses scientific principles in solving real-world problems. The education behind engineering has been the most effective way to prepare students for jobs that require creativity, system design, and

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problem-solving [1]. Many applications in engineering are present in the lives of engineering students, and mathematics serves as a very important field in this discipline.

Mathematics is a fundamental course in engineering. It is the foundation of all engineering fields. The students' performance in mathematics courses can significantly affect their overall success, and students, through proper interventions, can exhibit positive attitudes towards mathematics [2]. However, many engineering students struggle with mathematics, leading to high attrition rates and lower overall success in the field [3]. Moreover, students struggle with mathematical thought processes and the intricacy of mathematical objects [4]. While cognitive factors such as intelligence and prior knowledge play a crucial role in mathematics performance, non-cognitive factors like mathematical resilience and achievement goals also contribute to students' success [3, 5]. Student motivation and engagement are widely recognized indicators of educational quality and learning success [6]. Thus, it is imperative to consider mathematical resilience and achievement goals of engineering students as important factors in their academic and professional success. Developing successful ways to enhance the teaching and learning processes requires an understanding of the non-cognitive elements that influence students' performance in mathematics, the role of emerging educational technologies and adaptive learning systems in shaping student engagement and performance [7], as well as the instructional design and learning structures that support engagement, feedback, and progression in higher education learning [8].

Mathematical resilience and achievement goals are non-cognitive factors that have been found to be associated with the mathematics performance of students [9]. Mathematical resilience pertains to the capacity of learners to approach mathematics with confidence and perseverance, as well as the capacity to go beyond any obstacles in the way of their mathematical development [10, 11]. It is the student's attitude in responding positively in encountering difficulty in mathematics achievement [12] and the ability, which can help students in overcoming challenges and difficulties in solving mathematical problems [13]. Strongly resilient students are able to acquire the mathematical abilities they need for daily life. In addition to learning the theory, people with these mathematical resilience abilities are able to adjust to any challenges they face [14]. On the other hand, achievement goals pertain to the different reasons or motivations for actions that impact performance [9].

In this context, the mathematics performance of engineering students is of particular interest. This study considered the engineering students of Camarines Sur Polytechnic Colleges (CSPC), Philippines. The engineering curriculum in the institution was designed for senior high school graduates under the STEM strand. Strategies to enhance the performance of students have been included, such as the inclusion of the course on Fundamentals of Engineering Mathematics at the first-year level [15].

This study aims to determine the mathematics performance, mathematics resilience, and achievement goals of students across the five engineering programs. Also, the relationships between the mathematics performance, mathematics resilience, and achievement goals were explored. By understanding the role of these non-cognitive factors, it is necessary to identify strategies to improve the mathematics performance of engineering students and promote their success in the field.

2 METHODOLOGY

A correlational research design was employed in exploring the relationship between the variables of the study. It facilitates the prediction and explanation of the relationship among variables [16]. Similarly, the correlational design makes no

effort to alter, modify, or tamper with the variable, nor does it try to explain the association [17].

Civil engineering, electrical engineering, electronics engineering, mechanical engineering, and computer engineering were among the first-year engineering students from CSPC who participated in the survey. The officially enrolled students for the first-year level during the school year 2023–2024 are 945. They were 269 from civil engineering, 239 from electrical engineering, 111 from electronics engineering, 236 from mechanical engineering, and 90 from computer engineering.

The Mathematics Resilience Scale (MRS) was used in the study [18]. This instrument measures students' attitudes toward studying mathematics. Under MRS, there are three factors, namely, value, struggle and growth. Moreover, the Achievement Goal Questionnaire-Revised (AGQ-R) [19] was also used. Mastery-approach (MAP), mastery-avoidance (MAV), performance-approach (PAP), and performance-avoidance (PAV) goals are the four dimensions that make up this questionnaire, each of which has three items. The following interpretations of the Likert scale were applied: 4.50-5.00-Strongly Agree (SA); 3.50-4.49-Agree (A); 2.50-3.49-Neutral (N); 1.50-2.49-Disagree (D); and 1.00-1.49-Strongly Disagree (SD).

Questionnaires were distributed to first-year engineering students based on the total enrolled students. The retrieval rate is 30.37% (287 out of 945). The number of retrieved questionnaires exceeded the minimum sampling rate of 281. The retrieval rate per program is as follows: 27.51% (74 out of 269) for BSCE, 33.05% (79 out of 239) for BSEE, 34.23% (38 out of 111) for BSECE, 26.69% (63 out of 236) for BSME, and 36.67% (33 out of 90) for BSCPE.

3 RESULTS AND DISCUSSIONS

The mathematics performance of students across the five engineering programs is summarized in Table 1. The data is grouped into five performance categories based on grade ranges.

Table 1. Mathematics performance

Grade Range	BSCE		BSEE		BSECE		BSME		BSCPE		Overall	
	f	%	f	%	f	%	f	%	f	%	f	%
1.30–1.00 (95–99)	0	0	0	0	1	2.63	0	0	0	0	1	0.35
1.75–1.40 (90–94)	5	6.76	2	2.53	1	2.63	1	1.59	0	0	9	3.14
2.20–1.80 (85–89)	24	32.43	27	34.18	5	13.16	2	3.17	9	27.27	67	23.34
2.60–2.25 (80–84)	34	45.95	45	56.96	14	36.84	20	31.75	21	63.64	134	46.69
3.00–2.70 (75–79)	11	14.86	5	6.33	17	44.74	40	63.49	3	9.09	76	26.48
Total	74	100	79	100	38	100	63	100	33	100	287	100

It is noted that for the range 1.30–1.00 (95–99), there is only one student in total across all programs, coming from BSECE. In the range 1.75–1.40 (90–94), there is a slight increase. The BSCE program has five students (6.76%), the highest among the programs. The BSEE program has two students (2.53%), while the BSECE, BSME, and BSCPE programs have lower or no representation in this range.

The 2.20–1.80 (85–89) range reveals a larger portion of students. The BSEE program, with 27 (34.18%) students has the largest portion in this range. The BSECE and BSME have fewer, with five (13.16%) and two (3.17%) students, respectively.

The BSCPE program has nine (27.27%) students, showing a relatively balanced distribution across the programs.

The largest portion of students is in the range 2.60–2.25 (80–84) with 134 (46.69%) students out of 287, which constitutes nearly half of the total number of students. The BSEE shows the largest number with 45 (56.96%) and BSCE with 34 (45.95%) students. The rest show substantial representation with 14 (36.84%) students for BSECE, 20 (31.75%) students for BSME, and 21 (63.64%) for BSCPE.

The range 3.00–2.70 (75–79) also shows a significant portion of students, particularly in the BSME program, having 40 (63.49%) students. The BSECE also has a notable portion with 17 (44.74%) students. The BSCE and BSEE have lower proportions, with 11 (14.86%) and five (6.33%) students, respectively. The BSCPE program shows the least representation with only three (9.09%) students along this range.

The results in Table 2 show a comparative analysis of the mathematics performance of the students across the five engineering programs. In this table, the lower mathematics performance scores indicate higher mathematics achievement, while higher scores correspond to lower mathematics achievement.

Table 2. Average mathematics performance

Program	Average Mathematics Performance	SD
BSCE	2.3	0.38
BSEE	2.4	0.41
BSECE	2.6	0.51
BSME	2.3	0.31
BSCPE	2.7	0.26
Overall	2.4	0.40

The findings reveal that among the engineering programs, the BSCE and BSME have the highest mathematics performance, with an average score of 2.3. These results show that students in these programs have better mathematics performance. However, the BSCPE program shows the lowest average mathematics performance (2.7), indicating lower achievement among its students. The BSEE and BSECE programs fall between these extremes, having scores of 2.6 and 2.4, respectively.

The differences in mathematics performance among the programs may be associated with several factors, including curriculum structure, student engagement, and the availability of academic support. However, one reason behind BSCE and BSME students having higher mathematics performance is the students enrolled in these programs. It is noted that during admission, these two programs are the popular choices among incoming students. As a result, the top students are accepted into these programs. However, the low academic performance of BSCPE students suggests that there may be difficulties for the students. One of the contributing factors is the absence of a licensure examination for the BSCPE program, which may lead students to neglect their studies and not focus adequately on mathematics courses.

Table 3 shows the results of the survey on mathematics resilience along with value that provides valuable insights on the perception of students on the role and significance of mathematics in their academic, professional, and personal lives.

Table 3. Mathematics resilience – Value

Value	WM	SD	Interpretation
V1. Math is essential for my future.	4.46	0.73	A
V2. Math will be useful to me in my life's work.	4.34	0.75	A
V3. Math courses are very helpful no matter what I decide to study.	4.25	0.78	A
V4. Knowing math contributes greatly to achieving my goals.	4.38	0.75	A
V5. Having a solid knowledge of math helps me understand more complex topics in my field of study.	4.52	0.69	SA
V6. Thinking mathematically can help me with things that matter to me.	4.28	0.76	A
V7. It would be difficult to succeed in life without math.	4.07	0.85	A
V8. Math develops good thinking skills that are necessary to succeed in any career.	4.45	0.77	A
Overall	4.34	0.61	A

The results suggest a strong agreement among students in recognizing the importance of mathematics across dimensions of their future. The findings are supported by literature and studies highlighting the role of mathematics in developing the conceptual understanding and problem-solving skills of students, as well as their preparedness for the workforce. On the statement for V1, the result indicates that students believe that mathematics is crucial to achieving their long-term goals. This supports the literature that claims that the foundation for critical thinking and problem-solving is mathematics. A study emphasizes that mathematical thinking cultivates habits of precision and logical reasoning, which are valuable across all disciplines [20]. V2 reflects the practical application of mathematical skills in professional settings. This view is supported by the study, which identified analytical thinking and problem-solving as key skills for the future workforce, many of which are grounded in mathematics [21].

The responses to the statement for V3 further support the concept that mathematics is relevant to various disciplines. The students appreciate that regardless of their field of study, mathematics helps in enhancing their knowledge and skills. This finding aligns with the study that argues that the problem-solving abilities developed through mathematics are essential in a wide variety of academic disciplines [22]. For the indicator V4, it understands that students give consideration that mathematics can contribute to achieving their goals. This is further supported by the study, which highlighted the important role of mathematics in various aspects of development, including social, intellectual, and moral, among others [23]. These are development aspects that an individual needs to further support the achievement of their goals.

The high agreement with the statement V5 further supports the belief of the students that mathematics is relevant in studies, more specifically to advanced courses. This result further explains the interdisciplinary relevance of mathematics to fields that require technical and scientific understanding. According to a study, mathematics is a crucial tool for understanding difficult subjects, especially in STEM fields [24]. Students believe that mathematics can provide the tools needed that are crucial to their academic and professional success.

The statement V6 suggests that students see the value of mathematics beyond their academic endeavors. Also, V7 received the lowest means, suggesting that

students view mathematics as important in life and vital to their success. Outside of the workplace, mathematical knowledge and procedures are helpful in understanding and interpreting news reports and events so that one is not duped or influenced by the opinions of others without a valid reason. This enhances one's own quality of life when one is able to live a purposeful and accountable life [25]. Students recognize the wide applications in day-to-day problem-solving, which reflects a deeper appreciation of the value of mathematics.

Finally, the statement V8 shows that students perceived that mathematics develops thinking skills useful for the success of their careers. This finding is supported by the study, which highlights how mathematical training fosters problem-solving and reasoning skills that are applicable across various domains [18].

Table 4 presents the findings on Mathematics Resilience under Struggle. The students' perceived responses show agreement with struggles associated with learning mathematics.

Table 4. Mathematics resilience – Struggle

Indicators	WM	SD	Interpretation
S1. Everyone struggles with math at some point.	4.49	0.78	A
S2. Good mathematicians experience difficulties when solving problems.	4.23	0.84	A
S3. People who work in math related fields sometimes find math challenging.	4.35	0.77	A
S4. Everyone makes mistakes at times when doing math.	4.65	0.67	SA
S5. Struggle is a normal part of working on math.	4.64	0.72	SA
S6. People in my peer group struggle sometimes with math.	4.52	0.73	SA
S7. People who are good at math may fail a hard math test.	3.91	1.03	A
S8. Making mistakes is necessary to get good at math.	4.49	0.76	A
Overall	4.41	0.60	A

The agreement for the first indicator, S1, suggests that the students believe that at any time, there are challenges and difficulties in mathematics encountered. This aligns with the study highlighting that making mistakes and encountering difficulties can stimulate brain activity, which may lead to improved knowledge and skills [26].

The indicators S2 and S3 consider a wide understanding that experts, too, face difficulties and challenges. This finding is supported by the idea that even highly skilled individuals should be engaged in challenging activities to improve their skills [27]. This supports the concept that facing difficulty is not an indicator of weakness but rather a sign of engagement with complex phenomena.

Making mistakes is a crucial part of learning. It might be viewed as constructive stimulants that upset the equilibrium necessary for introspection and mental reorganization [28]. The agreement on statement S4 supports this. Lee's study points out that learning from mistakes is one possible solution to achieving more effective learning. Likewise, errors provide essential feedback, which fosters deeper cognitive engagement [29]. Similarly, S8 and S5 are supported by these findings from literature that making mistakes is one way for enhanced learning. When students struggle and make mistakes, they are more likely to keep going rather than give up. A growth mindset highlights that skills may be acquired via work and by overcoming obstacles [30].

The agreement on statement S6 supports the idea of collective resilience. Collective resilience pertains to the ability of human beings to adjust and deal with hardships as a group [31]. When students perceive that their peers are also struggling, it helps normalize their own challenges and reduces feelings of isolation. This sense of shared experience is supported by collaborative learning environments. Students working together in solving problems lead to better outcomes [32].

The statement S7 reflects the perception that even highly capable individuals face challenging situations. On the study of productive failure, it suggests that failing in a difficult task can lead to deeper learning, providing an opportunity for the learner to reflect and analyze afterward [33].

Table 5 provides important understanding on the belief regarding mathematics resilience, and growth mindset among students. Statement G1 suggests that the majority of the students firmly believe that learning, perseverance, and effort may improve one’s mathematical skills. This finding agreed with Dweck’s theory of a growth mindset, which signifies that intelligence and abilities are not fixed; it can be cultivated through hard work. Similarly, academic tenacity—mindsets and abilities that enable students to study harder and “smarter” over time—influences long-term learning [34].

Table 5. Mathematics resilience – Growth

Indicators	WM	SD	Interpretation
G1. Math can be learned by anyone.	4.52	0.76	SA
G2. If someone is not a math person, they won’t be able to learn much math.	3.26	1.27	N
G3. If someone is not good at math, there is nothing that can be done to change that.	2.74	1.40	N
G4. People are either good at math or they aren’t.	3.64	1.00	A
G5. Everyone’s math ability is determined at birth.	2.64	1.38	N
G6. Some people cannot learn math.	2.70	1.31	N
G7. Only smart people can do math.	2.30	1.45	D
Overall	3.11	0.92	N

Along with statement G2, it reflects a neutrality on the responses of the students—some students may lean toward this mindset view, and others may disagree. Responses on G3 also reveal a neutral response from the students. Others suggest that some students still believe that mathematical ability is unchangeable, while others reject this notion. Students who believe in the statement are those who are less likely to engage in problem-solving when they encounter challenges [26].

The statement G4 emphasizes that most students believe math can be learned; however, a significant portion believe that mathematical ability is somewhat fixed (some are naturally good at math, while others are not). A moderate standard deviation of 1.00 indicates that while a significant portion of respondents may agree with the statement, there is also a range of differing opinions.

The statements G5 and G7 received the lowest weighted means. This reflects a general perception of the idea that mathematical ability is innate or fixed. There is no inherent gender-based difference in math ability, which counters the belief in math being “determined at birth” and highlights the influence of societal and cultural factors on mathematical performance [35]. When individuals understand

that intelligence is not a fixed trait, they are more likely to engage in challenging tasks, persist through difficulties, and ultimately improve their performance in areas like mathematics [34].

On statement G6, results show variability in responses, reflecting that while many people reject the notion that some individuals are inherently unable to learn math, others may still hold this fixed mindset belief. However, literature strongly counters this idea. Everyone has the potential to succeed in math if given the right learning environment and support. She also highlighted that mathematical ability is not a fixed trait but can be developed through hard work, persistence, and effective learning strategies [26].

Table 6 shows the result of achievement goals across the four categories. According to goal orientation theory, performance goals are primarily focused on peer comparison, whereas mastery goals emphasize personal growth and comprehension [36].

MAP goals emphasize learning and self-improvement. Students are driven to learn in order to advance their knowledge and skills when they have MAP goals, which push them to master or understand the task they are working on [36].

Table 6. Achievement goals

Mastery-Approach Goals	WM	SD	Interpretation
AG1. My aim is to completely master the material presented in my classes.	4.36	0.75	A
AG3. My goal is to learn as much as possible.	4.58	0.71	SA
AG7. I am striving to understand the content of my courses as thoroughly as possible.	4.44	0.74	A
Overall	4.46	0.63	A
Mastery-Avoidance Goals			
AG5. My aim is to avoid learning less than I possibly could.	3.85	1.16	A
AG9. My goal is to avoid learning less than it is possible to learn.	3.85	1.12	A
AG11. I am striving to avoid an incomplete understanding of the course material.	4.18	0.92	A
Overall	3.96	0.91	A
Performance-Approach Goals			
AG2. I am striving to do well compared to other students.	3.98	0.93	A
AG4. My aim is to perform well relative to other students.	4.26	0.86	A
AG8. My goal is to perform better than the other students.	3.76	1.14	A
Overall	4.00	0.83	A
Performance-Avoidance Goals			
AG6. My goal is to avoid performing poorly compared to others.	4.12	0.99	A
AG10. I am striving to avoid performing worse than others.	3.97	0.98	A
AG12. My aim is to avoid doing worse than other students.	3.99	0.99	A
Overall	4.03	0.88	A

The indicator AG1 reflects a strong commitment among students to understand the material fully. Students that are learning goal-oriented typically concentrate on honing their abilities or completing the assignment at hand [37]. This is consistent with research showing that students who have learning objectives are more likely to use deeper learning techniques. The statement AG3 indicates that the primary goal of students is to maximize learning. The finding agreed with previous studies that mastery-approach goals lead to greater cognitive and metacognitive engagement [19] and transfer of knowledge and skills, which may then enhance performance [38].

The statement AG7 demonstrates students' dedication to thoroughly comprehend the material, and the students' focus is not just on mastering the material but also on actively striving to achieve deep understanding.

The overall result for the MAP goals is the highest among demonstrating students' motivation and desire to master their coursework. Findings from studies show that students with MAP goals tend to have better learning outcomes, including increased academic resilience and intrinsic motivation [39].

The MAV goal is defined as engaging in an activity to prevent losing previously acquired knowledge or abilities [40]. The statements AG5 and AG9 suggest that students focused on avoiding learning less than their full potential. This may often be motivated by a fear of not achieving mastery. This can lead to a focus on the negative aspects of learning, such as anxiety over not grasping the material fully [39].

The statement AG11 reflects that students are associated with anxiety. These are often results of over-preparation or fear of missing important concepts, which can negatively impact their overall performance [36]. PAP goals are centered on proving one's skill in comparison to others [36]. On the statement AG2, this emphasizes an agreement reflecting competitive orientation among students. There is evidence that students' participation in the learning process is linked to their academic competitiveness [41]. However, a slightly lower mean suggests that some prioritize personal learning over competition.

The statements AG4 and AG8 show that students' performance is driven by external validation and comparison, which can result in enhanced academic achievement. Excessive social comparison can boost one's self-esteem to the point that it affects academic performance [42].

PAV goals refer to the drive to avoid performing worse than others [43]. On the statement AG6, students are associated with a fear of performing worse than others. Students who experience anxiety negatively impact their performance and persistence [44]. Likewise, the statement AG10 is linked to academic anxiety and lower intrinsic motivation, as students focus more on not failing than on achieving success [45]. Finally, the statement AG12 can contribute to fear and anxiety that may impede student achievement. This performance-avoidance goal has been linked to poorer academic achievement as students become preoccupied with avoiding failure rather than striving for success [36].

3.1 Correlation between study variables

The correlation coefficients presented in Table 7 show the relationship between the mathematics performance, mathematical resiliency, and achievement goals of engineering students.

Table 7. Correlation coefficients

Variable	M	SD	1	2	3	4	5	6	7
1. Academic Performance	2.40	0.40							
2. Value	4.34	0.61	-0.123*						
3. Struggle	4.41	0.60	-0.181*	0.244*					
4. Growth	3.11	0.92	0.188*	0.089	0.040				
5. MAP goals	4.46	0.63	-0.100	0.582*	0.339*	0.017			
6. MAV goals	3.96	0.91	-0.062	0.347*	0.189*	0.290*	0.563*		
7. PAP goals	4.00	0.83	0.021	0.396*	0.181*	0.314*	0.559*	0.676*	
8. PAV goals	4.03	0.88	-0.020	0.397*	0.174*	0.312*	0.546*	0.760*	0.750*

Note: * $p < 0.05$ (2-tailed); $N = 287$.

The academic performance shows a negative correlation with both value ($r = -0.123$, $p < 0.05$) and struggle ($r = -0.181$, $p < 0.05$). This finding reveals that as students give importance to the value of mathematics in their academic, professional, and personal lives, they tend to have lower academic achievement. This finding aligns with previous studies regarding disconnect between students' perceived value of mathematics and their academic performance. These can be attributed to various factors, including mathematics anxiety [46, 47] and self-efficacy [48], among others. Similarly, academic performance shows an inverse relationship with perceived struggle. This finding is supported by previous studies, revealing that an increase in stress negatively impacts the performance of students [49, 50]. A positive correlation is found between academic performance and growth ($r = 0.188$, $p < 0.05$). This indicates that students with a growth-oriented mindset tend to have higher academic performance and excel academically. This is consistent with the findings on growth mindset and learning outcomes, viewing challenges as opportunities to improve [30]. However, no significant correlations are found between academic performance and any of the four goals.

Value is correlated with MAP goals ($r = 0.582$, $p < 0.05$) and MAV goals ($r = 0.347$, $p < 0.05$). Likewise, for the PAP goals ($r = 0.396$, $p < 0.05$) and PAV goals ($r = 0.397$, $p < 0.05$), the value is positively correlated. According to the results, students who place a high value on their academic work are more likely to develop mastery and performance-oriented goals. The correlation with MAP goals suggests that students who value their work are more likely to pursue self-improvement and competence [48]. For the correlation between value and struggle, there exists a positive correlation ($r = 0.244$, $p < 0.05$), which implies that students who value their academics may experience higher levels of struggle due to the increased importance and demands they place on their studies.

Struggle is moderately correlated with MAP goals ($r = 0.339$, $p < 0.05$) and MAV goals ($r = 0.189$, $p < 0.05$). These correlations imply that students with mastery-oriented goals often face more academic struggles, possibly due to their emphasis on mastering difficult material [19]. A positive correlation with PAP goals ($r = 0.181$, $p < 0.05$) and PAV goals ($r = 0.174$, $p < 0.05$) further reveals that students also experience struggle when striving to outperform others or avoid failure.

Growth is positively correlated with MAV goals ($r = 0.290$, $p < 0.05$), PAP goals ($r = 0.314$, $p < 0.05$), and PAV goals ($r = 0.312$, $p < 0.05$). These correlations imply

that students who have growth mindsets are also more inclined to pursue performance-oriented goals, such as aiming for achievement or avoiding failure, reflecting a balanced view of both internal growth and external validation.

MAP goals are correlated with MAV goals ($r = 0.563$, $p < 0.05$). This suggests that students focused on mastering content also carry a concern about avoiding a decline in their competence. This dual focus illustrates how students strive for growth while also fearing regression in their knowledge or abilities. Likewise, MAP goals have a positive correlation with PAP goals ($r = 0.559$, $p < 0.05$) and PAV goals ($r = 0.546$, $p < 0.05$). These results indicate that students aiming to improve themselves intrinsically may also be motivated by external factors. Moreover, students pursuing mastery may also experience anxiety about performing worse than others.

MAV goals exhibit positive correlation with PAP goals ($r = 0.676$, $p < 0.05$). This result suggests that students driven by a fear of losing competence may also seek to outperform others. It appears that students who aim to perform better than others and who want to prevent personal problems might have competing goals, which could result in high success but also high pressure [51]. Similarly, the positive correlation between MAV goals and PAV goals ($r = 0.760$, $p < 0.05$) shows the shared avoidance-oriented motivation. Preventing negative outcomes is the main objective of both, whether they are related to personal competence or relative performance. This implies that students are not only concerned with avoiding a decline in their abilities but are also anxious about being perceived as inferior to others [19].

The PAP goals correlate with the PAV goals ($r = 0.750$, $p < 0.05$). This result suggests that students who are motivated to perform better than others may also be concerned about the potential of underperforming. These students probably feel both a fear of failing and a desire to succeed [52].

4 RECOMMENDATIONS

The study's findings support the necessity of offering thorough recommendations to improve engineering students' mathematical resilience. Likewise, these recommendations were gathered through the inputs from the students.

- a) Incorporate techniques that foster active learning. Included are gamification, collaborative learning, and technology, which will make learning more enjoyable and accessible. The connection between theoretical math and real-life situations helps bridge the gap and motivates students to learn as they see its direct impact on their lives. A variety of examples when introducing new mathematical concepts will help understand and accommodate different learning styles.
- b) Incorporate real-world applications in math lessons to make the course more relevant and engaging. The connection between theoretical math and real-life situations helps bridge the gap and motivates students to learn as they see its direct impact on their lives.
- c) Provide a variety of examples when introducing new mathematical concepts. This will help understand and accommodate different learning styles. Encouraging students to explore multiple methods to solve a problem fosters flexible thinking.
- d) Provide professional assistance to faculty members teaching mathematics courses. Professional development is essential for faculty members to stay updated on new teaching techniques, technologies, and pedagogical theories. This continuous learning will ensure that faculty members are better prepared to address the evolving needs of the students and make the course more engaging and enjoyable.

- e) Provide additional support to students who need more time or personalized instruction to master mathematical concepts. Encourage students to engage in peer tutoring, which helps students to learn from each other. Student organizations can assist in the conduct of regular tutorial classes or learning sessions in mathematics.
- f) Provide additional courses on mathematics specifically to cater to students who are not STEM. The college can provide a strategy on how to incorporate additional courses so that students from non-STEM can cope with the basic and foundational skills in mathematics.
- g) Provide workbooks and other learning resources to support independent study and reinforce classroom learning. Introduce online platforms that offer additional practice and personalized feedback, catering to individual learning needs.
- h) Regularly conduct assessment methods and timely feedback to track students' progress. Encouraging students to reflect on their performance and set goals for improvement can foster a growth mindset where they take ownership of their learning.

5 CONCLUSIONS AND POLICY IMPLICATIONS

This study examines the mathematics performance, resiliency, and achievement goals of engineering students. Results indicate different levels of performance. Findings reveal that there is a negative correlation between mathematics performance and resiliency along with value and struggle. These findings show that difficulties in learning and high intrinsic value for mathematics may hinder academic success. However, a positive correlation between academic performance and mathematical resiliency along with growth suggests that students who believe in their ability to improve tend to achieve better results. Academic performance shows no significant correlation with any of the achievement goals, which suggests that even though these goals shape students' attitudes and behaviors toward learning, they may not directly translate into academic performance. The study's findings highlight several important policy implications. The institution should incorporate the growth mindset principle into the curriculum to help students view challenges as opportunities for improvement. Support systems for students struggling with mathematics, such as mentorship programs, are important to reduce the impact of struggle on performance. Policies should shift focus toward fostering resilience and emotional well-being. Balancing students' passion for mathematics with strategies that prevent overwhelming pressure will enhance both academic performance and their overall learning experience.

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