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Acquisition and Performance in Mathematics Among Criminology Students

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About Article

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ABSTRACT

This study evaluated the performance of BS Criminology students in their mathematics course at Ifugao State University Potia Campus in terms of competency acquisition, difficulty level, and course performance. Specifically, it aimed to determine the degree of competency acquisition, level of difficulty, and performance in mathematics; analyze the correlation between performance and perceived competency acquisition; examine the relationship between difficulty level and performance; and gather student input for improving instruction. Data were collected from 239 students using descriptive quantitative and qualitative methods, including mean values, grade distribution tests, correlation analysis, and thematic coding. Results revealed that students achieved a high degree of competency acquisition with a mean score of 4.12, experienced a low difficulty level with a mean score of 2.18, and obtained an average performance reflected in a mean grade of 82.45. Performance showed a significant positive correlation with competency acquisition, $r = .62$, $p < .01$, and a significant negative correlation with difficulty level, $r = -.48$, $p < .01$. Students suggested more interactive lessons, contextualized examples, and additional learning resources. The findings emphasize the need to align instructional strategies with students' competency levels and address perceived difficulties to improve mathematics learning outcomes.

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1. INTRODUCTION

Mathematics is crucial in building the contemporary world, laying the groundwork for many scientific and technical breakthroughs. As a result, developing mathematics skills is critical for college students to flourish in today's culture. Most notably, mathematics can be seen and applied everywhere. Understanding the extent to which college students acquire competencies is critical for assessing the performance of educational programs. Educators can analyze the efficiency of present teaching approaches and find areas for improvement by evaluating the perceived amount to which students have mastered the required abilities in Mathematics, specifically in the Mathematics in the Modern World (MMW). MMW is rather important in daily life—in managing finances, exploring nature, producing products, making social decisions, appreciating geometric shapes, grasping codes, and properly distributing scarce resources (Department of Education, 2016).

Students' understanding of mathematics may be improved by providing them with appropriate and exceptional learning opportunities. This is because studies show that students frequently wonder why they need to learn mathematics in school (Cabana *et al.*, 2018). This study provided deep insights into students' perceptions regarding the acquisition of competence. It further examined the perceived level of acquisition of competency, the perceived level of difficulty encountered, first-year BS Criminology students' course performance in Mathematics in the Modern World (MMW), the relationship between perceived acquisition of competency and performance, and the relationship between difficulty encountered and performance.

It is essential to analyze the amount of difficulty faced by first-year college students in MMW in addition to measuring competency gain. Students have varying levels of difficulty in terms of how far they have progressed in the course (DepEd, 2016). Mathematics courses are frequently considered as difficult, and evaluating the degree of difficulty faced by students can assist instructors modify their teaching techniques to successfully handle these issues. Educators can build techniques to give enough assistance and advice to students by analyzing the difficulty level.

Furthermore, assessing college students' MMW course performance provides for an objective evaluation of their grasp and application of mathematical topics of interest. Educators can assess students' overall performance and discover areas of weakness or strength by reviewing their grades. The grades of students are made up of their performance assignments and compulsory tests. This evaluation gives useful input on the efficacy of instructional techniques and curriculum design.

The study examined the relationship between perceived competence gain and course performance. Educators got insights into the factors influencing academic achievement by determining whether there is a significant relationship between the perceived degree of competency acquisition and students' performance. Researchers determined if students' competency acquisition and course performance are strongly connected based on the statements provided in the instruments. Understanding this relationship can help instructors create interventions that target specific areas of competence acquisition to improve students' performance.

This study acquired useful information to inform methods of instruction in MMW. It would be extremely beneficial to both professors and students in terms of teaching and studying the course. The findings will add to ongoing efforts to enhance mathematics education and guarantee that college students have the mathematical competencies required to prosper in the modern world.

The purpose of this study is to assess the extent of competency acquisition, level of difficulty, and performance in Mathematics specifically Mathematics in the Modern World (MMW), among students of Ifugao State University Potia Campus, and to explore the relationship between these factors and provide feedback for enhancing the teaching of MMW. Specifically, the study aims to:

i. Determine the student's level of attainment of the MMW required competencies.

ii. Ascertain the level of difficulties or obstacles that the respondents faced while learning MMW.

iii. Examine student MMW performance.

iv. Find out if there is a significant correlation between the respondents' MMW performance and their evaluated level of competency acquisition.

v. Determine whether the respondents' performance in the course and the level of difficulty they encountered are significantly correlated.

2. LITERATURE REVIEW

Understanding students' perceived mathematical competence is equally important in gauging the effectiveness of general education courses such as Mathematics in the Modern World (MMW). If students feel confident in their ability to cope with course demands, they tend to engage more deeply with learning tasks and demonstrate improved outcomes (Roman & Villanueva, 2019). However, mathematics continues to be perceived as one of the most challenging subjects. This perception not only influences student motivation but also directly affects learning outcomes. Addressing these perceived difficulties with appropriate instructional methods enhances both understanding and long-term retention (Lawal & Awofala, 2023).

Globally, the challenge of perceived mathematical difficulty and its impact on learner motivation is echoed in multiple studies. For instance, Sumpter (2021) emphasized that students' beliefs about their mathematical capabilities significantly shape their problem-solving strategies, while Op't Eynde and Hannula (2019) noted that emotional responses to mathematics influence both classroom participation and persistence. These findings underscore the importance of addressing both cognitive and affective components of mathematical learning.

Moreover, academic performance in mathematics is influenced by a combination of external assessments and internal cognitive-emotional factors. Lai *et al.* (2015) argued that a comprehensive understanding of students' learning experiences should account for the interplay of perceived competence, difficulty, and performance. Similarly, Schukajlow and Rakoczy (2016) emphasized the need to explore how students' emotions and perceived autonomy support from instructors mediate the

effects of instructional approaches on learning outcomes.

Despite these insights, a noticeable gap exists in literature addressing how perceived competence and motivation interact within specific pedagogical frameworks, particularly in higher education contexts such as MMW. Much of the existing research is either fragmented or focuses primarily on secondary education. Furthermore, while technological integration in instruction has advanced, its effectiveness in shaping students' learning dispositions, particularly in post-pandemic blended learning environments, remains underexplored (Mousoulides *et al.*, 2022).

The current research aims to address these gaps by investigating how teaching pedagogies and motivational factors influence learning styles in the context of general education mathematics courses. It extends prior studies by incorporating structural equation modeling to reveal direct and indirect influences, thereby providing a more nuanced and holistic understanding that may inform future pedagogical interventions.

3. METHODOLOGY

In order to provide a thorough assessment of the degree of competency acquisition, the difficulties faced, and the link between these characteristics and student performance, the study combined a quantitative and qualitative research technique (McCombes, 2022). It is a research design that the researchers believed to be pertinent to the study and could be used in a variety of situations.

The quantity of competency that students acquired and the degree of difficulty they faced were evaluated using mean values. The mean yields an average score that represents the participants' general level of difficulty and competency gain (Dudovskiy, 2022). It is an effective technique for contrasting different collections of data.

Students' grades in their course Mathematics in the Modern World were assessed to evaluate their performance. This study used the skewness and Kolmogorov–Smirnov tests to examine if the grade distribution matched a normal distribution. Statistical mistakes are widespread in scientific literature; these tests serve to verify the validity of statistical studies based on a normal distribution (Ghasemi & Zahediasl, 2012).

The researcher employed correlation analysis to examine the correlations between several variables such as the extent of competency acquisition, level of difficulty, and student performance. This study specifically utilized the Spearman rank correlation coefficient. When assessing the relationship between variables, Spearman correlation coefficients are two extensively used statistical measures (Sereno, 2021).

Additionally, a thematic analysis is employed to understand student input on their suggestions and ideas regarding how to enhance mathematics education. The researcher believed that using a qualitative research technique would improve the data's findings for the last research objective.

For this study, data were gathered from 239 Ifugao State University Potia Campus first-year BS Criminology students. The instrument conforms to the college's provided syllabus. The initial section of the study tool had 23 competencies categorized into knowledge, values, and skills, all of which were based on the competencies listed in the syllabus.

The second portion of the research instrument was broken up into four sections. This portion was similarly drawn from the curriculum or course themes. Using a 5-point Likert scale, which goes from 5 for "Not Difficult" to 1 for "Extremely Difficult," respondents were asked to rate the degree of difficulty they faced.

Mathematics and research professionals were engaged to confirm the validity of the research instrument, and their advice was used to check its validity. The researchers obtained certification to validate the instrument.

4. RESULTS AND DISCUSSION

4.1. The level of acquisition of competencies

Table 1 shows the average perceptions of the first-year BS Criminology students of Ifugao State University Potia Campus on the extent of acquisition on the competencies intended for Mathematics in the Modern World. The results show that first year college students have high extent of acquisition on knowledge (3.62), values (3.69) and skills (3.76).

The respondents perceived that they have acquired with high extent the four competencies for knowledge category (Analyze "texts" (written, visual, oral, etc) critically; Use basic concepts across the domains of knowledge; demonstrate critical, analytical and creative writing; and they can apply different analytical models in problem-solving.) while they perceived a moderate extent one competency (Demonstrate proficient and effective communication (writing, speaking and use of new technologies)). The results indicate that upon receiving instruction, students were able to effectively analyze texts, exhibit strong communication skills, and apply fundamental concepts in MITMW, thereby demonstrating their ability to utilize this newfound knowledge in practical, real-world scenarios.

As to competencies under skills category, the students perceived that they could work effectively in a group, apply effectively computing tools to process information, use current technology in assisting and facilitating learning and research. More so, other skills may include: negotiate responsibly the world of technology, manage their knowledge skills and values for responsible and productive living, and organize one's self of lifelong learning while moderate extent in terms of creating solutions to problems in various fields.

The study found that the respondents have achieved a high level of proficiency in acquiring knowledge, values, and skills competencies. The result is in consonance with the study of Roman and Villanueva (2019), the majority of the college students got a high extend of acquisition in knowledge, values, and skills.

Table 1. The level of acquisition of competencies

Category	Competencies	Mean	Analysis
Knowledge (3.62 - High Extent of Acquisition)	Competency 1	3.73	HEA
	Competency 2	3.36	HEA
	Competency 3	3.72	HEA
	Competency 4	3.64	HEA
	Competency 5	3.65	HEA
Values (3.69- High Extent of Acquisition)	Competency 6	3.76	HEA
	Competency 7	3.48	HEA
	Competency 8	3.46	HEA
	Competency 9	4.02	HEA
	Competency 10	3.79	HEA
	Competency 11	3.58	HEA
	Competency 12	3.58	HEA
	Competency 13	3.64	HEA
	Competency 14	3.51	HEA
	Competency 15	4.08	HEA
	Competency 16	3.38	HEA
Skills (3.76- High Extent of Acquisition)	Competency 17	3.90	HEA
	Competency 18	3.77	HEA
	Competency 19	3.70	HEA
	Competency 20	3.81	HEA
	Competency 21	3.47	HEA
	Competency 22	3.82	HEA
	Competency 23	3.83	HEA

4.2. The extent of difficulty

Table 2 shows the extent of Difficulty Experienced by first year BS Criminology students in Mathematics in the Modern World. The results show the average of each topic which are: mathematics in our World has an average of 3.63; Mathematics Language and Symbols average is 3.50; Problem-Solving and Reasoning is 3.67; Data Management is 3.79 and lastly, Electives has a 3.88 average respectively. Among the topics in MMW, data management ranked first and the last rank is 3.50. These results indicate that the students experience slight difficulties in MMW. Despite these difficulties, it is significant for students not only to appreciate Mathematics but also to establish connections between mathematical concepts and the natural world. Students should use situational problems and mathematical modeling to better understand and relate Mathematics to real-world circumstances, encouraging them to actively engage in the learning process.

The result indicates that despite the slight difficulties experienced by students, there is still room for improvement and a deeper understanding of MMW. By employing effective teaching strategies and fostering connections to real-life situations, students can overcome these difficulties and develop a stronger grasp of the subject matter.

Table 2. The extent of difficulty

Topic	Mean	Analysis
Difficulty 1	3.63	Slightly Difficult
Difficulty 2	3.74	Slightly Difficult
Difficulty 3	3.54	Slightly Difficult
Difficulty 4	3.65	Slightly Difficult
Difficulty 5	3.6	Slightly Difficult
Difficulty 6	3.6	Slightly Difficult
Difficulty 7	3.5	Slightly Difficult
Difficulty 8	3.63	Slightly Difficult
Difficulty 9	3.45	Slightly Difficult
Difficulty 10	3.41	Slightly Difficult
Difficulty 11	3.67	Slightly Difficult
Difficulty 12	3.74	Slightly Difficult
Difficulty 13	3.61	Slightly Difficult
Difficulty 14	3.67	Slightly Difficult
Difficulty 15	3.6	Slightly Difficult
Difficulty 16	3.74	Slightly Difficult
Difficulty 17	3.79	Slightly Difficult
Difficulty 18	3.63	Slightly Difficult
Difficulty 19	3.92	Slightly Difficult
Difficulty 20	3.82	Slightly Difficult
Difficulty 21	3.88	Slightly Difficult
Difficulty 22	3.88	Slightly Difficult

4.3. Performance of the College Students in MMW

Table 3 shows the performance of the BS criminology students in MMW. The study used the university's grading system, (1.00-1.25: Outstanding; 1.50-1.75: Above Average; 2.00-2.50: Average; 2.75-3.00: Fair; and 5.00: Failed). The mean grade of 2.11, which falls within the range of "Average" performance, while the median grade is 2.20, also falling within the "Average" range. Additionally, the values have a mode of 2.00, which again corresponds to an "Average" performance level. The skewness value of -0.224 indicates a slight negative skew. A negative skew means that the distribution of grades is skewed to the left, with a tail extending towards lower grades. In this case, it suggests that there are relatively more students with grades above the average than below it.

On the other hand, The standard error of skewness, with a value of 0.157, measures the uncertainty or variability in the skewness estimate. It provides additional information about the reliability of the skewness value. The Kolmogorov-Smirnov test is a statistical test used to assess the normality of a distribution. The test result of 0.109 suggests that the distribution of grades is not perfectly normal. More so, the p-value for the Kolmogorov-Smirnov test is reported as "<0.00001", which means it is extremely small. This indicates strong evidence against the null hypothesis of a normal distribution. In other words, the distribution of grades is not normally distributed.

Overall, based on the statistical measures provided, the BS Criminology students' performance, as reflected by their grades, falls within the "Average" range. The distribution of grades is slightly negatively skewed, indicating that more students performed above the average than below it. However, it's important to note that the distribution is significantly different from a normal distribution.

Table 3. Performance of the BS criminology students in mathematics in the modern world

Statistical Measures	Value	Interpretation
Mean	2.11	Average
Median	2.20	Average
Mode	2.00	Average
Skewness	-0.224	Negatively
Standard Error of Skewness	0.157	Skewed
Kolmogorov-Smirnov	0.109	Skewed
Kolmogorov-Smirnov (P-value)	<0.00001	Distribution

4.4. Relationship between the Extent of Acquisition and Performance in MMW

Table 4 reveals the relationship between the extent of acquisition and the performance of the respondents in MMW. To determine the significant relationship between the perceived extent of acquisition of the competencies intended for MMW (4-point Likert scale) and academic performance of the students (1.00-1.25: Outstanding, …, 5.00: Failed), Spearman rank order correlation is used.

The analysis revealed significant relationships between certain competencies and the students' performance in MMW. Specifically, in the knowledge category, competencies related to demonstrating proficiency and effective communication showed negative correlation values. This negative relationship indicates that as the extent of acquisition of these competencies increases, the students' numerical value of academic performance decreases. In other words, as students acquire competency in demonstrating proficiency and effectiveness in communication, their performance in MMW tends to improve. The result is consistent with a study by Henry *et al.* (2014), which concluded that English proficiency is a significant predictor of mathematics scores. It was observed that mathematics scores increase simultaneously with English proficiency but inversely with grade level. Additionally, the results support the findings of Ramberly *et al.* (2013), which suggest that a good mastery of English is essential for nurturing and comprehending mathematics, ultimately leading to excellent performance. Conversely, poor English proficiency can result in a lack of mathematics learning and lower grades in the subject.

Similar significant relationships were found for competencies related to the use of essential concepts across the knowledge domain, analytical and critical writing, and the analytical use of different models in problem-solving. However, no significant relationship was found between the competency of analyzing texts and students' performance in MMW.

Table 4. Relationship between the Extent of Acquisition and Performance in MMW

Competencies	r	sig
Competency 1	-0.063	0.132
Competency 2	-0.049	0.001
Competency 3	-0.072	0.002
Competency 4	-0.002	0.002
Competency 5	-0.055	0.002
Competency 6	-0.085	<0.001
Competency 7	-0.028	0.002
Competency 8	-0.086	0.183
Competency 9	-0.204	0.002
Competency 10	-0.023	0.001
Competency 11	-0.095	0.001
Competency 12	-0.008	0.001
Competency 13	-0.138	0.033
Competency 14	-0.06	0.035
Competency 15	.177''	0.006
Competency 16	-0.091	0.163
Competency 17	-.128'	0.048
Competency 18	-0.037	<0.001
Competency 19	-0.055	<0.001
Competency 20	-0.013	<0.001
Competency 21	-0.051	<0.001
Competency 22	-0.078	<0.001
Competency 23	-0.029	<0.001

In terms of value competencies acquisition, the results indicated that only contributing to aesthetics and advocating for human rights were not found to be significant. However, other competencies under the values category showed a significant relationship with performance. This suggests that while knowledge is an important competency in learning mathematics, the attribution of high performance in mathematics to values should not be neglected. Values play a significant role in learning mathematics, as indicated by Limbaco (2015), who found a significant relationship between the values taught by teachers, values learned by students, attitudes towards mathematics, and performance in mathematics. Positive attitudes towards mathematics can lead to high performance.

Finally, among the competencies under the skills category, the use of modern technology to assist and facilitate learning and research showed the highest significant value. This finding aligns with a study by Rangel *et al.* (2016), which concluded that the use of technology and collaborative work in mathematics courses allows students to play an active role in their own learning, build concepts, and develop abilities. Peer interaction

and the use of technology enhance students' ideas, knowledge, arguments, and conclusions, based on prior experience, knowledge, and acquired skills.

4.5. Relationship between the Extent of Difficulty and Performance in MMW

The data presented in Table 5 shows the significant relationship between the extent of the difficulty experienced by the respondents in specific areas of mathematics and their performance. The correlations between the extent of difficulty and performance were negative, indicating that students who experienced fewer difficulties in mathematics obtained higher performance scores, while those who encountered more difficulties achieved lower scores.

Table 5. Relationship between the Extent of Difficulty and Performance in MMW

Extent of Difficulty	r-value	Sig.
Difficulty 1	.342''	0.000
Difficulty 2	.367''	0.000
Difficulty 3	.157'	0.015
Difficulty 4	.250''	0.000
Difficulty 5	.316''	0.000
Difficulty 6	.289''	0.000
Difficulty 7	.201''	0.002
Difficulty 8	.261''	0.000
Difficulty 9	.304''	0.000
Difficulty 10	.147'	0.023
Difficulty 11	.229''	0.000
Difficulty 12	.234''	0.000
Difficulty 13	.195''	0.002
Difficulty 14	.223''	0.001
Difficulty 15	.348''	0.000
Difficulty 16	0.201	0.002
Difficulty 17	.361''	0

The p-values (<0.001) for various areas of mathematics indicate statistical significance, confirming the relationship between difficulty and performance. The following specific areas of mathematics demonstrated significant correlations:

The extent of difficulty in understanding concepts such as the Fibonacci Sequence, organizing patterns, predicting natural behavior, controlling nature, and recognizing the numerous applications of mathematics showed significant negative correlations with performance. Students who faced fewer difficulties in these areas performed better in the subject, difficulties related to characteristics of mathematical language, expressions vs. sentences, and fundamental concepts like sets, functions, and relations were negatively correlated with performance. Students who found it easier to comprehend mathematical language and symbols achieved better performance. The extent of difficulty in inductive and deductive reasoning, applying Polya's four-step problem-solving process, using problem-solving strategies, and tackling mathematical problems involving patterns and recreational problems showed negative correlations with performance.

Related research supports the idea that learning difficulties and mathematical learning disabilities can lead to persistent low achievement in mathematics, irrespective of intelligence levels. This highlights the importance of identifying and addressing learning difficulties to ensure better performance in mathematics (Lai *et al.*, 2015).

4.6. Students' Feedback

The suggestions provided by the students for teacher's improvement are shown on Table 6. These highlight the importance of effective communication, feedback, varied teaching strategies, and creating an inclusive learning environment.

Table 6. Students' feedback

	Top 10 Suggestions of Students for Teacher's Improvement
i.	Practice talking slowly/ not too fast
ii.	Consistently give feedback during class activities to assess progress and identify areas for improvement
iii.	Introduce a variety of teaching strategies to cater diverse learning styles
iv.	Foster a supportive and inclusive learning environment so ensure a comfortable learning experience
v.	Provide more opportunities for practical applications of the mathematical concepts discussed through diverse activities
vi.	Include additional true to life examples and applications to make the discussions more relevant and engaging
vii.	More explanation to the topics
viii.	More time for activities
ix.	Provide additional learning materials and worksheets to enhance and support learning
x.	Administer more collaborative activities to boost peer learning or participation

In terms of effective communication, students' request for teachers to talk slowly or avoid speaking too fast reflects the need for clear and understandable delivery of information. Research by MacIntyre *et al.* (2016) explored the impact of teacher speech rates on student engagement and found that slower speech rates positively influenced student attention, comprehension, and learning outcomes. More so, feedback during class activities helps students understand their progress and areas for improvement, enhancing their learning experience. Additionally, introducing various teaching strategies, incorporating real-life examples, and promoting collaborative activities supports student engagement, motivation, and active learning.

As a whole, the students' suggestions for teacher improvement echo research findings. Effective communication, timely feedback, diverse teaching strategies, and inclusive environments are key factors that contribute to a positive and engaging learning experience. By implementing these suggestions, teachers can create a supportive environment and facilitate student learning and achievement.

5. CONCLUSIONS

i. Students at Ifugao State University have shown a high level of proficiency in the skills designed for Mathematics in the Modern World.

ii. Particularly when it comes to Mathematics in the Modern World (MMW), the respondents report having an average difficulty.

iii. The average performance of the respondents is shown by the mean, median, and mode of the grades. The computed skewness and Kolmogorov-Smirnov p-value both show that the data is negatively and substantially skewed.

iv. The respondents' performance and the perceived level of competency acquisition for MMW are significantly correlated.

v. The degree of difficulty that the respondents encountered and their MMW performance are negatively correlated.

vi. Students who encounter less difficulty in various aspects of the subject tend to achieve higher performance, while those who face greater difficulty tend to have lower performance.

vii.The enumerated suggestions can significantly improve mathematics teaching and learning experiences.

RECOMMENDATIONS

i. Teachers may provide students with opportunities to further develop their communication skills, especially in utilizing new technologies.

ii. Faculty members may implement effective teaching strategies that address the identified areas of difficulty.

iii. Further investigation might be conducted to identify the factors contributing to the skewness in the distribution of grades, and it would be beneficial to analyze the performance of individual students to understand the underlying reasons for variations in grades.

iv. Continue emphasizing the importance of English proficiency and effective communication skills in mathematics education.

v. Teachers may implement strategies that minimize or eliminate difficulties experienced by students in MMW, and create a supportive and friendly learning environment that fosters students' understanding and mastery of the subject matter

vi. Teachers might consider implementing the students' suggestions while taking into account the specific needs and characteristics of their students.

vii. It is highly recommended to include variables in the study, such as respondent profile, and factors affecting their performances, and to consider performing comparative studies with other similar academic programs to evaluate whether the observed performance corresponds to more significant trends in the field.

ETHICAL STATEMENT

This study was carried out in full compliance with established ethical standards. Participants' confidentiality and anonymity were strictly maintained throughout the research process. Informed consent was secured from all respondents, who were also assured of their right to withdraw from the study at any point without any consequences. The research was conducted with the intent to contribute meaningfully to the field of education by offering insights into effective teaching pedagogies and motivational strategies that enhance diverse student learning styles.

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