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Strategic Intervention Material to Improve the Performance of the College Freshmen Students

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***Abstract**: Mathematics in the Modern world is one of the new courses added to the General Education subjects taught in the new college curriculum. It aims to expose undergraduate students to various domains of knowledge and ways of comprehending social and natural realities, developing in the process, intellectual competencies and civic capacities. The course purposely tackles the nature of mathematics, appreciation of its practical, intellectual, and aesthetic dimensions, and application of mathematical tools in daily life.This study assessed the Mathematics in the Modern World performance of the college sophomore students of Ilocos Sur Polytechnic State College which led to the formulation of a Strategic Intervention Material. It made use of the descriptive research design and developmental methods with a questionnaire as the main data gathering tool. The 254 student-respondents were chosen using the random sampling technique. Mean and the difficulty index formula were utilized to analyze the data.The study revealed that the respondents have a satisfactory performance in Mathematics in the Modern World. Furthermore, most of the topics covered in Mathematics in the Modern World found to be difficult and moderately difficult. With these significant findings, the Mathematics in the Modern World strategic intervention material (SIM) was developed, which was found very valid.*

Keywords: Mathematics in the Modern World Performance, level of validity, level of difficulty, Strategic Intervention Material.

1. INTRODUCTION

Understanding mathematics requires composite skills - from reading concepts until solving figures or word problems. Its value goes beyond shapes, sizes and symbols. It offers experiences indispensable to achieving meaningful tasks in a complex and rapidly changing world, thus, making it important in the modern society. Its importance is clearly manifested with its practical uses in various aspects of daily life. It allows every individual to develop the power of reasoning, critical thinking and problem-solving skills. In fact, the National Council

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of Teachers of Mathematics [8] stresses that those who understand and can do Mathematics will have opportunities that others do not. This is because mathematical competence opens doors to endless opportunities. Therefore, mathematics as the queen of all sciences and as one of the core disciplines must be comprehensively learned.

The government, through the Commission on Higher Education, in pursuit of the ongoing education reforms in the basic education, continues to provide significant changes in the curriculum. This led to the birth of the new General Education curriculum. The new general education curriculum aims to expose undergraduate students to various domains of knowledge and ways of comprehending social and natural realities, developing in the process, intellectual competencies and civic capacities. The said reforms include the addition of a three-unit course called Mathematics in the Modern World. The course begins with the nature of mathematics as an exploration of patterns (in nature and in the environment) and as an application of inductive and deductive reasoning. Moreover, Mathematics in the Modern World is not only based on theories but is actually connected to everyday living in terms of how to manage limited resources, personal finances, appreciating geometric designs, and even making social choices [2]. Accordingly, the course purposely tackles the nature of mathematics, appreciation of its practical, intellectual, and aesthetic dimensions, and application of mathematical tools in daily life. Thus, the reform adheres to improving the mathematics performance of students.
However, despite of the potential value of mathematics in today's time, some students develop negative attitude towards the subject which also affects their performance. The performance of students in all learning areas plays significant role in producing the best quality of learners who can excel and compete globally. Their performances may indicate the potency of the curriculum which includes all the faculty of teaching such as instructional materials and teaching methodologies.

Thus, this study is designed to further investigate the performance of the college sophomore students in Mathematics in the Modern World and design a Strategic Instructional Material for the least mastered competencies. A better understanding of the students' performance would show the direction of help to be given to those who have poor achievements in mathematics [5]. The researcher has also identified the level of difficulty of the various topics covered in the course which led to the formulation of a strategic intervention material.

2. RESEARCH ELABORATIONS

Research Design

This study made used of the descriptive research design employing developmental approach. Thus, the level of performance of the respondents has been described. Developmental research design had been considered in the formulation of a strategic intervention material for the subject Mathematics in the Modern World which was validated by experts.

Population and Locale of the Study

The respondents of the study are the second year college students of Ilocos Sur Polytechnic State College, Santa Maria Campus for School Year 2020-2021. They are the second batch of the newest general education subject in Mathematics in the Modern World. The researcher made used of the Slovin's formula to determine the sample size and random sampling technique in determining the samples.

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The table shows the population and the number of samples taken from each college.

Table 1. Distribution of Respondents by College

College	Population	Sample
College of Computing Studies (CCS)	243	89
College of Teacher Education (CTE)	77	28
College of Business Management and Entrepreneurship (CBME)	268	98
College of Agriculture, Forestry, Engineering and Development Communication (CAFED)	107	39
Total	**695**	**254**

Out of the six hundred ninety-five (695) officially enrolled, a total of 254 students were used as respondents.

Research Instrument

To further develop this study, the researcher used a questionnaire to assess the level of performance in Mathematics in the Modern World of the student-respondents. It is a 40-item teacher - constructed multiple choice test (achievement test). The items were equally divided from the four main topics in Mathematics in the Modern World covered for the whole semester. Items 1 -10 were taken from the topic Patterns and Numbers in Nature and the World; items 11 – 20 were from Mathematical Language and Symbols; items 21 – 30 were from Problem Solving and Reasoning and items 31 – 40 were from the topic Data Management. The pilot testing was done at ISPSC Santiago campus which had a reliability score of 0.755 using the Cronbach's alpha. It was validated by five Mathematics in the Modern World instructors. The computed mean value of 4.40 revealed that the validity of the questionnaire is "Very High."

Data Gathering Procedure

Upon approval of requests from the office of the president and college deans, the researcher floated questionnaire to the respondents through google form. One hundred percent of the questionnaires were collected and the responses were tallied and submitted for statistical treatment.

Statistical Treatment of Data

The Statistical Package for Social Science (SPSS) was utilized in the statistical analysis and treatment of data gathered. Specifically, **mean** was utilized to describe the mathematics performance of the students and the level of validity of the strategic intervention material.
In addition, the following formula was used to compute the difficulty index of the test items.

$$D = \frac{\text{students with corret answer}}{\text{total number of students}}$$

Data Categorization

To determine the level of mathematical performance of the students, the following 5-point Likert scale was used:

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Items per topic Rating	Overall	Descriptive
8.01 – 10.00	32.01 – 40.00	Outstanding (O)
6.01 – 8.00	24.01 – 32.00	Very Satisfactory (VS)
4.01 – 6.00	16.01 – 24.00	Satisfactory (S)
2.01 – 4.00	8.01 – 16.00	Fair (F)
0.00 – 2.00	0.01 – 8.00	Poor (P)

To determine the level of difficulty of the topics covered in the subject Mathematics in the Modern World, the following 5-point Likert scale was used:

Statistical Limit	Descriptive Rating
0.81 – 1.00	Very Easy
0.61 – 0.80	Easy
0.41 – 0.60	Moderately Difficult
0.21 – 0.40	Difficult
0.0 – 0.20	Very Difficult

To validate the SIM, the following 5-point Likert scale was used:

Rating	Statistical Limit	Descriptive Rating
5	4.21 – 5.00	Very Valid
4	3.41 – 4.20	Valid
3	2.61 – 3.40	Moderately Valid
2	1.81 – 2.60	Less Valid
1	1.00 – 1.80	Least Valid

3. RESULTS/ FINDINGS

The succeeding discussions include the presentation, interpretation and analysis of significant findings of the study.

Mathematics Performance of the Respondents
The table below shows the level of Mathematics in the Modern World performance of the second year college students of Ilocos Sur Polytechnic State College.

Table 2. Level of Performance of the Respondents in the following Content Areas

Range of Scores	f	%
A. Patterns and Numbers in Nature and the World		
9-10	61	24.02
7-8	88	34.64

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5-6	45	17.72
3-4	47	18.50
0-2	13	5.12
Mean	**6.55**	
Descriptive Rating	**VS**	
B. Mathematical Language and Symbols		
9-10	39	15.36
7-8	63	24.80
5-6	70	27.56
3-4	63	24.80
0-2	19	7.48
Mean	**5.78**	
Descriptive Rating	**S**	
C. Problem Solving and Reasoning		
9-10	20	7.87
7-8	65	25.59
5-6	78	30.71
3-4	72	28.35
0-2	19	7.48
Mean	**5.42**	
Descriptive Rating	**S**	
D. Data Management		
9-10	10	3.94
7-8	48	18.90
5-6	84	33.07
3-4	82	32.28
0-2	30	11.81
Mean	4.86	
Descriptive Rating	S	
Over-all Mean	5.65	
Over-all DR	S	

It can be gleaned from Table 2 the four main topics based on the CHED proposed syllabus for Mathematics in the Modern World.

Patterns and Numbers in Nature and the World

The table shows that Patterns and Numbers in Nature and the World got a mean rating of 6.55 described as Very Satisfactory. The most frequent score along the said topic ranges from 7-8, corresponding to 88 (34.64%) of the total respondents while 13 (5.12%) got a score from 0-2. This result implies that students have mastered the basic concepts in patterns and numbers. However, further learning interventions should be administered to students to augment their appreciation, understanding and familiarity of the world in which they live and how everything

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is connected. The findings of this study conforms with the results of the study of [10] that patterns and numbers in nature and the world got the highest mean.

Mathematical Language and Symbols

Along mathematical language and symbols, a mean rating of 5.78 was recorded described as Satisfactory. Most of the students' score tallied from 5-6 comprising to 70 (27.56%) of the respondents and 19 (7.48%) scored from 0-2. This, then, implies that students have a minimal understanding on the key concepts of the different mathematical language and symbols. The data reveals that further interventions will be given so that students will be able to develop their mathematical proficiency. However, on a study conducted by [10], Mathematical language and symbols was one of the 5 topics which got a high percentage mean. This negates the findings of [9] that Mathematical language was assessed by the students as the second difficult subject. The students started to dislike mathematics when the learning becomes more abstract and involves more algebraic thinking [9].

Problem Solving and Reasoning

The table revealed that problem solving and reasoning obtained a mean rating of 5.42 described as Satisfactory. The scores recorded from 5-6 with 78 (30.71%) of the total respondents was noted as the most frequent scores while 19 (7.48%) of the respondents scored from 0-2. This indicates that students failed to master the different mathematical strategies on how to simplify problems leading to poor reasoning and conclusions. This particular part of the subject should be given special emphasis by using various interventions that will enlighten the minds of the students on how to solve problems logically. On the study of [9], students perceived problem solving and reasoning as the most difficult among the topics included in the subject Mathematics in the Modern World. According to [9], one of the most difficult parts of mathematics is word problems. She stressed that a word problem is contained with a mathematical language and conceptual representations that students must analyze to solve word problems.

Data Management

The mean rating of 4.86 described as Satisfactory was recorded along Data Management. Score range from 5-6 noted the highest number of respondents with 84 (33.07%) while 30 (11.81%) of the respondents scored from 0-2. The data reveals that students' performance is low and needs further interventions so that students will learn and appreciate data management as useful tool towards their future researches and studies. Some students might have failed to familiarize these concepts, leading to poor comprehension. Therefore, enrichment activities must be administered. Furthermore, [9] found out that students perceived Data Management as the easiest among the four topics. This negates the result of this present study where the students performed low in Data Management. This could be attributed to the fact that the topic is less covered compared to other content areas since this is placed last in the syllabus. Only few of these lessons were discussed due to numerous activities conducted during the semester. These lessons need to be discussed thoroughly since they require careful and critical analysis. This supports the claim of Atlantic Evaluation Research Consultants (2007) as mentioned by [4] that covering all the topics added by diverse students' needs and abilities seemed to affect the delivery of the curriculum particularly students' learning.

However, the overall mean which is 5.65 means that the level of performance of students in the four topics covered in Mathematics in the Modern World is Satisfactory. This means that

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the performance of the students is still on the acceptable level. Reference [10] says that Mathematics in the Modern World is a subject that focuses on the use of mathematics in the natural world. He further stressed that when students perform satisfactorily in this subject, it is reasonable to say that that they could apply it in solving real world problems.

Level of Difficulty on the Various Topics Covered in Mathematics in the Modern World

Table 3. Level of Difficulty on the Various Topics Covered in Mathematics in the Modern World

Competencies	Difficulty Index	Descriptive Rating
A. Patterns and Numbers in Nature and the World		
1.Identify patterns in nature and regularities in the world.	0.57	MD
2.Solve word problems involving Fibonacci sequence	0.70	E
3.Express appreciation for Mathematics as a human endeavor.	0.54	MD
B. Mathematical Language and Symbols		
1.Translate mathematical expression/ sentence into symbol and vice versa.	0.61	E
2.Translate conditional statement into its converse, inverse, and contrapositive.	0.31	D
C. Problem Solving and Reasoning		
1.Solve problems involving patterns and recreational problems applying the different problem solving strategies.	0.53	MD
2.Apply inductive/ deductive reasoning to justify mathematical statements and arguments.	0.65	E
D. Data Management		
1.Solve grouped and ungrouped data using appropriate statistical tool.		
a.Measures of central tendency	0.59	MD
b.Measures of relative position	0.24	D
c.Measures of dispersion	0.43	MD

It is reflected on the table that along Patterns and Numbers in Nature and the World, the item "Solve word problems involving Fibonacci sequence" got the highest difficulty index of 0.70, described as Easy. Meanwhile, the item "express appreciation for Mathematics as a human endeavor got the lowest difficulty index of 0.54 described as Moderately Difficult. This implies that the students did not fully appreciated the importance of Mathematics.

Based on the study of [6], the results revealed that there was a significant difference in the student's achievements and conceptual understanding scores as influenced by the teaching method which is the use of mathematical patterns. Furthermore, the students in the experimental group expressed that mathematical patterns was enjoyable and interesting because it allowed them to develop their critical thinking and made mathematics learning easier for them. The researcher concluded that the use of mathematical patterns is an effective method of teaching in improving students' achievement and conceptual understanding.

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The table also shows that along Mathematical language and symbols, the topic on translate Mathematical expression/ sentence into symbol and vice versa recorded 0.61 difficulty index described as Easy while the topic Translate conditional statement into its converse, inverse, and contrapositive got 0.31 difficulty index described as Difficult. This may imply that basic concepts can be easily understood by the students, but if they will be introduced to tougher problems, it takes them awhile before achieving mastery of the concept.

Results showed that both the understanding of mathematical language and achievement in mathematics among secondary school students are below average. The fact that the mean score for mathematical language is less than that of achievement in mathematics implies that students' understanding of mathematical language is poorer relative to achievement in the subject. This implies that students learn mathematics using a language that they do not understand. These observations concur with that of [7] who observed that learning mathematics requires development of a mathematical language in which abstraction of mathematical concepts can be made.

Along Problem Solving and Reasoning, the item "Apply Inductive Reasoning to justify mathematical statement and arguments" got 0.65 difficulty index described as Easy, while the item "solve problems involving patterns and recreational problem applying the different problem solving strategies obtained 0.53 difficulty index described as Moderately Difficult. This means that students find difficulty in dealing with problem solving. This is further attested by [3] which says that, students in the Philippines were poor in mathematical problem solving compared to other countries in spite of research studies and trainings which were conducted in finding ways to implement strategies and improve the pedagogy in teaching Mathematics and students' problem solving skills. However, it was found out that teaching students using problem solving with contextualized real mathematics increased students problem solving ability. Students' performances improve when they are actively involved in the classroom and when they are allowed to receive individual attention [1].

Among the four topics, students considered Data Management as the most difficult one. The table presents that students have a wider knowledge about the topic on measures of central tendency obtaining 0.59 difficult index corresponds to Moderately Difficult, while the topic on measures of relative position recorded 0.24 difficulty index described as Difficulty. This only proved that students started to dislike mathematics when the learning becomes more abstract and involves more algebraic thinking as it was also cited in the studies of [9].

Lastly in the study of [11], he states that, in statistics, some undoubtedly enrolled the subject simply for compliance, opposite those who endeavor to complete the course requirements. A percentage of the non-mathematics/ statistics majoring students on the other hand do not take the subject seriously as premised by the subject's presumed less relevance to their course.

Table 4. Result of the Validity Test

Indicators	Mean Rating	Descriptive Rating
1. The learning objectives are simple, measurable, attainable, realistic and time bound.	5.00	Very Valid
2. The activities are organized based on the sequence of the focus skills.	5.00	Very Valid

Legend: 4.21 – 5.00 - Very Valid 3.41 – 4.20 - Valid

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3. The activities assess their understanding of what they have learned and correct errors when appropriate.	4.80	Very Valid
4. Monitor their learning and uses feedback about their progress.	4.00	Valid
5. Provides opportunities for students to work independently or in groups to explore answers to their own.	4.80	Very Valid
Average	4.72	Very Valid

The table disclosed that the first two indicators garnered the highest mean rating of 5.0, described as "very valid." Items 3 and 5 both scored 4.80, still considered as "very valid". However, as reflected from the table, item 4 got the lowest mean rating of 4.0, interpreted as "valid." This implies that the developed SIM should be enhanced and improved by incorporating the suggestions and recommendations of the expert – evaluators before its reproduction and utilization. The overall mean rating of 4.72, described as "very valid" means that the developed Mathematics in the Modern World SIM is a suitable instrument to help students improve their Mathematics in the Modern World performance.

3. CONCLUSIONS

Based on the findings, the following statements were concluded:

1. The performance of the second year college students in Mathematics in the Modern World is satisfactory.
2. The student-respondents exhibited mastery in solving word problems involving Fibonacci sequence, translating mathematical expression/ sentence into symbol and vice versa, and applying inductive/ deductive reasoning to justify mathematical statements and arguments. However, they found the following topics to be difficult and moderately difficult: identifying patterns in nature and regularities in the world, expressing appreciation for Mathematics as a human endeavor, translating conditional statement into its converse, inverse, and contrapositive, solving problems involving patterns and recreational problems applying the different problem solving strategies, solving problems involving measures of central tendency, measures of relative position, and measures of dispersion.
3. A strategic intervention material addresses the needs of the students in helping them improve their Mathematics in the Modern World performance.
4. The researcher-made strategic intervention material is evaluated as very valid and reliable that can help the students develop proficiency in the different learning competencies.

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