

MATHEMATICS ABILITY AND PERFORMANCE ENHANCEMENT (MAPE): A SUPPLEMENTARY INTERVENTION MATERIAL IN DEVELOPING STUDENTS' MATHEMATICS PERFORMANCE

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ABSTRACT

This study aimed to determine the validity of the supplementary intervention material in developing students' mathematics performance, sought to determine the level of students' mathematics performance upon exposure to the intervention material, determined the students' perception on the use of the intervention material, determined the significance of the intervention material to students' mathematics performance, and determined the relationship of students' mathematics performance and students' perception on the use of the intervention material. To validate the supplementary intervention material and describe the perceptions of the students, pre-experimental research was employed. There were ninety-five (95) participants in the study composed of teachers and students who were purposely selected. The participants of the study were ninety (90) Grade 9 students at Pedro Guevara Memorial National High School, school year 2022-2023 which utilized the MAPE- as supplementary intervention material in developing students' knowledge of fractions. The researcher used researcher-made questionnaires which were validated by five master teachers in different Junior high schools in Laguna. The researcher also utilized the researcher-made questionnaires employing an open-ended semi-structured checklist for the key informants. The researcher employed a checklist for each of the participants and obtained some perceptions correlated to the research questions prepared by the researchers. After gathering the needed data, the researcher used thematic analysis or thematic coding as a tool for analyzing the data and drawing a conclusion. Based on the gathered data from the participants, the researcher noticed positive outcomes which were MAPE – a supplementary intervention material develops students' knowledge on fractions, MAPE – as supplementary intervention material is appropriate and useful to students, and MAPE- as supplementary intervention material improves students' mathematics performance. Because of the positive results of the gathered data, it is possible that MAPE- as supplementary intervention material will be vital in the near future as a material that develops students' knowledge in mathematics. With these results also, it was recommended that the mathematics teachers should make their own supplementary intervention material, school administrators should include the use of supplementary intervention material in their planning, and a similar study that has more participants and wider in scope should be conducted by future researchers.

Keywords:

Supplementary Intervention Material, Mathematics Performance

INTRODUCTION

Mathematics plays an important role in our daily lives. It helps us understand the world and provides an efficient way of building mental discipline. Math encourages logical reasoning, critical thinking, creative thinking, abstract and spatial thinking, problem-solving skills, and even effective communication skills. Mathematics is universal in a sense that other fields of human thought are not. It's useful in business applications, industry, music, historical scholarship, politics, sports, medicine, agriculture, engineering, and social and natural science.

Mathematics education in the Philippines is in a challenging state, even before the pandemic there are already depressing signs of an education crisis. The most widely disseminated news about the crisis came from the report of the Program for International Student Assessment (PISA) of the Organization for Economic Co-operation and Development (OECD) in 2018 which showed that Filipino students ranked lowest among the 79 countries in mathematics, science, and reading. In math and science, Filipino 15-year-old students obtained 353 points and 357 points, respectively, against the 489 OECD average for both categories.

In another international test, the 2019 Report of Trends in International Mathematics and Science Study (TIMSS), Filipino grade 4 students fared the lowest scores in Mathematics and Science among 58 countries. There was really a clear decrease from 2013 to 2019. The Philippines scores a deficit of 61 points from 358 in 2003 to 297 in mathematics. A third international test, the Southeast Asia Primary Learning Metrics (SEA-PLM) Program 2019 Main Regional Report revealed that Filipino grade 5 students only met 17% of the proficiency standard in mathematics.

Because of the worldwide pandemic where traditional classes are held, it was expected that Filipino students' poor performance would worsen. Students are unlikely to have a solid understanding of the topics in mathematics after two years of lockdown and using distance learning.

The researcher was motivated to conduct this study because of the deterioration of Mathematics education. The researcher believed that creating supplemental learning material could be beneficial in treating students' numeracy and mathematics performance.

The purpose of this study is to determine if Mathematics Ability and Performance Enhancement (MAPE) - A supplementary intervention material helps in developing students' performance in Mathematics.

Specifically, the study sought to find the following research questions:

1. What is the level of validation of MAPE as supplementary intervention material in terms of:
 - 1.1. objective;
 - 1.2. content;
 - 1.3. assessment; and
 - 1.4. appropriateness?
2. What is the level of students' Mathematics performance in terms of:
 - 2.1. Pre-test; and
 - 2.2. Post-test?
3. What is the level of student's perception of the use of MAPE as supplementary intervention material in terms of:
 - 3.1. language used; and
 - 3.2. usefulness?

4. Is there a significant difference on the level of students' mathematics performance in terms of Pre-test and Post-test?
5. Is there a significant relationship between the students' mathematics performance in terms of post-test and students' perception of the use of MAPE as supplementary intervention material?

REVIEW OF RELATED LITERATURE

K. Marunung (2017), asserts that instructional materials are one of the key elements of the teaching process. The curriculum's declared aims and the syllabus's formulated goals are achieved with the help of the instructional materials. From goals, measurable or operational verbs based on Bloom's Taxonomy are used to create instructional objectives, which are then generated or translated from goals. The instructional materials are developed and designed using the learning objectives as a guide to make sure they meet the needs of the learners, society, and learners in relation to society.

Espinar and Ballado's (2017) study, both groups of respondents concurred that the developed work text has content validity and is in line with the course syllabus for Basic Mathematics 2; the lesson objectives are content valid and adhere to the SMART principle; they are also pertinent to the course topics for Basic Mathematics 2; the lesson inputs section has content validity; the lessons clearly present the key concepts, and the background information is provided.

Suman F. Yudha (2019), learners need direction for classroom learning activities for them to achieve their intended goals. He claimed that the worksheet is created in such a way that it may be used for learning in all three areas: content, construct, and language. The developed product included in the category is judged to be legitimate based on the results of the validation that was done.

R. Sulastri et al (2018), study on designing modules, six mathematics-training modules met the criteria for being both valid and practical. The materials' and concepts' alignment with the curriculum and the challenges faced by instructors served as a sign of their validity. The efficiency, usefulness, and beauty of the training modules—which were divided into several different components with instructions and time estimates—as well as their legibility and ease of use—were the practical criteria.

According to Tipolo (2016), Strategic Intervention Material and the five basic parts of it, Strategic Intervention Material must be simple and easy to understand. His uploaded article gives steps and some advice in making an effective strategic intervention material. It also explains the different parts of the material. In an article by Rodrigo (2015), it is very identical to this by stating to keep the activities in a Strategic Intervention Material short and simple. The intervention material must be simplified and short enough for the students to understand and to be interested. The material being simplified is essential since the students need to understand it more easily compared to a regular class discussion of a subject matter.

Melati (2019), student worksheets are one source of knowledge that learners can use as a roadmap for reaching learning objectives when doing investigations or addressing problems. The worksheet's results for validation revealed that its content, grammar, and language were exceptionally legitimate in terms of the construct's presentational features. Aspects of purpose, engineering operations, usage accuracy, and operating principles are all evaluated through validation tools.

Keleijan (2017), pre-test processes are common in applied economic work and frequently involve statistical issues that are disregarded. Mestre (2012) asserts that pre- and post-tests are comparable to checklists in that they can be used to gauge students' needs prior to a tutorial and assess how effectively the tutorial satisfied those needs. To determine if a student was able to execute a task, process, or function as a result of the tutorial, pre-and post-tests are used with the same students.

Achenbach (2017), the central focus of many educational and clinical psychologist agendas is on evaluating intervention programs. A classic design with pre-and post-tests and follow-up assessments is an example of how data from multiple points in time can be collected to investigate the long-term strength of intervention effects once the treatment is over.

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Lee (2018) investigates the impact of a fraction intervention on the performance of math-challenged fifth graders. In three groups of two students, the researcher used a multiple probe multiple baseline approach for this investigation. The goal fractional performance of all groups was enhanced by the fraction interventions, according to the results of the visual analysis and effect sizes estimated. Two weeks after the intervention was over, the subjects kept the gain. The effect of the percent interventions was also substantial or almost substantial. Additionally, the fraction intervention seems to have lessened participant misconceptions, according on the findings of the misconception test. Participants' math abilities improved generally as a result of the fraction intervention. According to the social validity questionnaire's findings, everyone who took part had very favorable opinions of the fraction intervention.

METHODOLOGY

Pre-experimental research was employed in this study. A one-group pre-and post-test design for pre-experimental research was utilized, in which a group was given a pre-test, received treatment, and then received a post-test after being exposed to the supplementary intervention material. One-group pre-test–post-test design is a type of research design that is most often utilized by behavioral researchers to determine the effect of a treatment or intervention on a given sample. The respondents of the study were the ninety (90) grade 9 students handled by the researcher at Pedro Guevara Memorial National High School, School Year 2022-2023, and five master teachers from different junior high schools in Laguna who served as the experts in validating the supplementary intervention material that the researcher developed. The sample for the current study was chosen using a technique known as purposeful random sampling. To conduct the study, the researcher formulated the objectives, hypothesis, framework, and procedure. Then, seek the permission and approval of the school division superintendent, school principal and head teacher of Pedro Guevara Memorial National High School to conduct the study. The researcher developed and produced the cutting-edge learning resource material utilized as an intervention to address the issue. Five Master Teachers from different schools in Laguna checked and

reviewed the intervention material's validity. The department head, co-teachers, master teachers, and research adviser were then presented with the materials by the researcher for their feedback and evaluation. The learning content was then revised, modified, and developed in response to their comments and recommendations. After confirming the accuracy of the learning material, the researcher sent a letter requesting permission from the school head or principal to perform the study, collect data from the students, and use the material. The students were given a pre-test on fractions, which the advisor evaluated, to determine their proficiency with them. The teacher used a monitoring form to record the outcome. The instructor then conducted an intervention using the creative learning resource material. Prior to the start of class, the student completed homework at home and checked it. The assessment form was also used to record and keep track of the outcome. A post-test was given to the students once they had finished all of the topics. The data collected were tabulated and analyzed to determine the relationship between students' mathematics performance and students' perception on the use of the supplementary intervention material. The data were collected by following the standard operational procedures.

RESULT AND DISCUSSION

Table 1. Level of validation of Mathematics Ability and Performance Enhancement (MAPE) as Supplementary Intervention Material in terms of objectives.

Statement	Mean	SD	Remarks
Each lesson in the learning material is accompanied by a specific objective.	4.22	0.72	Strongly Agree
The objectives are well-planned, formulated, and organized.	4.45	0.69	Strongly Agree
The objectives are measurable and attainable.	4.12	0.85	Agree
The objectives are aligned with the learning competencies in the DepEd curriculum.	4.23	0.86	Strongly Agree
The objectives consider the needs of the students.	4.66	0.60	Strongly Agree
Overall Mean: SD	4.34 0.49		
Verbal Interpretation	Extremely Valid		

Legend: Scale	Range	Remarks	Interpretation
5	4.20 – 5.00	Strongly Agree	Extremely Valid
4	3.40 – 4.19	Agree	Valid
3	2.60 – 3.39	Moderately Agree	Moderately Valid
2	1.80 – 2.59	Disagree	Slightly Valid
1	1.00 – 1.79	Strongly Disagree	Not Valid at all

As shown in table 1, the respondents *strongly agree* that the objectives of the lesson in MAPE as supplementary intervention materials consider the needs of the students ($M=4.66$, $SD= 0.60$), are well-planned, formulated, and organized. On the other hand, respondents *agree* that the objective in each lesson is measurable and attainable ($M= 4.12$, $SD= 0.85$).

The overall mean of 4.34 indicates that the level of validation of MAPE as supplementary intervention material in terms of objective is *extremely valid*. This means that objects of the supplementary intervention material are accurate and parallel to the learning outcomes stated the in DepEd curriculum.

Table 2 shows that the respondents *strongly agree* that each topic was given an equal emphasis in the lesson ($M=4.40$, $SD= 0.58$), and the content of each lesson is directly relevant to the defined objectives. On the other hand, respondents *agree* that the content in each lesson is simple and easy to understand ($M= 4.00$, $SD= 0.89$).

The overall mean of 4.25 indicates that the level of validation of MAPE as supplementary intervention material in terms of content is *extremely valid*. This means that the content of the supplementary intervention material is supported by illustrative examples, and the practice tasks were suited to the level of the students.

Table 2. Level of validation of Mathematics Ability and Performance Enhancement (MAPE) as Supplementary Intervention Material in terms of content.

Statement	Mean	SD	Remarks
The content of each lesson is directly relevant to the defined objectives.	4.37	0.92	Strongly Agree
The content of each lesson is simple and easy to understand.	4.00	0.89	Agree
The topics of each lesson are fully discussed.	4.22	0.85	Strongly Agree
The topics are supported by illustrative examples, and the practice tasks are suited to the level of the students.	4.30	0.78	Strongly Agree
Each topic is given an equal emphasis in the lesson.	4.40	0.58	Strongly Agree
Overall Mean: SD	4.25: 0.58		
Verbal Interpretation	Extremely Valid		

Table 3. Level of validation of Mathematics Ability and Performance Enhancement (MAPE) as Supplementary Intervention Material in terms of assessment.

Statement	Mean	SD	Remarks
The way the module materials were presented helped to maintain the student's interest.	4.46	0.72	Strongly Agree
The instructions on how to complete the assessed tasks were easy to follow.	4.34	0.86	Strongly Agree
The module materials are related to the assessed tasks in this module.	4.39	0.90	Strongly Agree
There were enough examples to guide students to accomplish the given assessment.	4.23	0.72	Strongly Agree
The assessments were suited to students' level.	4.31	0.82	Strongly Agree
Overall Mean: SD	4.35: 0.52		
Verbal Interpretation	Extremely Valid		

As reflected in table 3, respondents *strongly agree* that the way the module materials were presented helped to maintain the student's interest ($M=4.46$, $SD=0.72$), the module materials are related to the assessed tasks, the instructions on how to complete the assessed tasks were easy to follow.

The level of validation of MAPE as supplementary intervention material in terms of its assessment is *extremely valid* with a mean of 4.35. This implies that the assessment of the supplementary intervention material is easy to accomplish and is suited to the learner's level.

As seen in table 4, respondents *strongly agree* that the presentation of each lesson is attractive and interesting to the students ($M=4.50$, $SD=0.75$), the lessons on the learning materials are presented in unique and original form, and there are adequate examples given in each topic in the material.

The level of validation of MAPE as supplementary intervention material in terms of its appropriateness is *extremely valid* with a mean score of 4.34 and implied that the supplementary intervention material is appropriate to students' level.

Table 4. Level of validation of Mathematics Ability and Performance Enhancement (MAPE) as Supplementary Intervention Material in terms of appropriateness.

Statement	Mean	SD	Remarks
The topics are presented in a logical and sequential order.	4.23	0.82	Strongly Agree
The lessons on the learning materials are presented in unique and original form.	4.34	0.75	Strongly Agree
The learning activities were presented clearly.	4.34	0.80	Strongly Agree
The presentation of each lesson is attractive and interesting to the students.	4.50	0.75	Strongly Agree
Adequate examples were given for each topic.	4.34	0.72	Strongly Agree
Overall Mean = 4.34	4.34:0.47		
Verbal Interpretation	Extremely Valid		

Table 5. Level of students' mathematics performance in terms of Pre-test.

Scores	Frequency	Relative Frequency	Remarks
9-10	0	0%	Advanced
7-8	1	1%	Proficient
5-6	6	7%	Approaching Proficient
3-4	17	19%	Developing
0-2	66	73%	Beginning
Total	90	100%	
Mean	1.43		Beginning
SD	1.79		

Table 5 illustrates the level of the Student's Performance in Mathematics in terms of Pre-test. From the pre-test, 66 out 90 students or 73% got a score of 0-2, and no student got a score of 9-10. It can be gleaned from the table that most of the scores of the respondents obtained by the score 0-2 got a mean score of 1.43 and a standard deviation of 1.79 with a remark of *Beginning*. This means that the students, before using the MAPE as Supplementary Intervention material do not have a minimum level of knowledge and core understanding about Fractions.

Table 6 revealed the level of the Student's Performance in Mathematics in terms of Post-test. There are 30 out of 90 students or 33% of the respondents got a score of 7-8; 28 out of 90 students or 31% got a score of 5-6; and 4 out of 90 students or 4% got a score from 0-2. It is evident from the data that after using the MAPE as Supplementary Intervention Material, respondents obtained a mean score of 6.13 and a standard deviation of 2.12 with a remark of *Proficient*. This means that respondents understanding of fractions has exceeded the core requirements and can transfer their understanding skills to solving

further Mathematical problems. It was also observed that 12 out of 90 students obtained an *Advance* performance in their Mathematics Performance.

Table 6. Level of students' mathematics performance in terms of Post-test.

Scores	Frequency	Relative Frequency	Remarks
9-10	12	13%	Advanced
7-8	30	33%	Proficient
5-6	28	31%	Approaching Proficient
3-4	16	18%	Developing
0-2	4	4%	Beginning
Total	90	100%	
Mean	6.13		Proficient
SD	2.12		

Table 7. Level of students' mathematics performance in terms of Post-test.

	Mean	SD	Remarks
Pre-test	1.43	1.79	Beginning
Post-test	6.13	2.12	Proficient

Range	Performance Remarks
9-10	Advanced
7-8	Proficient
5-6	Approaching Proficient
3-4	Developing
1-2	Beginning

Table 7 shows that the pre-test mean score ($M=1.43$) was at its *beginning* level while the post-test has ($M=6.13$) and is at its *proficient* level. The above result implies that MAPE-as Supplementary Intervention Material improved students' Mathematics performance. This indicates that the students were able to follow the correct information given which would lead them to correct responses.

Table 8 shows the level of students' perception on the use of MAPE- as supplementary intervention material in terms of the language used, the respondents *strongly agree* that the format/layout is well-organized which makes the lessons more interesting ($M=4.28$, $SD=0.89$), and the language used is clear, concise, and motivating. On the other hand, the respondents *agree* that the mathematical symbols used are well-defined ($M=4.17$, $SD=0.80$), and the instructions in the learning materials are concise and easy to follow. The overall mean is 4.19 which indicates that the language used in the supplementary intervention material is *highly* easy to understand and is appropriate to students' level of understanding.

Table 8. Students' Perception on the use of MAPE as supplementary intervention material in terms of

Language used.

Statement	Mean	SD	Remarks
The format/layout is well-organized which makes the lessons more interesting.	4.28	0.89	Strongly Agree

The language used is easy to understand.	4.12	0.83	Agree
The language used is clear, concise, and motivating.	4.31	0.76	Strongly Agree
The mathematical symbols used are well-defined.	4.17	0.80	Agree
The instructions in the learning materials are concise and easy to follow.	4.08	0.89	Agree
Overall Mean: SD	4.19: 0.57		
Verbal Interpretation	High		

Legend: Scale	Range	Remarks	Interpretation
5	4.20 – 5.00	Strongly Agree	Very High
4	3.40 – 4.19	Agree	High
3	2.60 – 3.39	Moderately Agree	Moderately High
2	1.80 – 2.59	Disagree	Low
1	1.00 – 1.79	Strongly Disagree	Very Low

Table 9. Students' Perception on the use of MAPE as supplementary intervention material in terms of usefulness.

Statement	Mean	SD	Remarks
The learning material motivates me to study fractions.	4.78	4.35	Strongly Agree
The learning material helps me master the topics at my own pace.	4.22	0.72	Strongly Agree
The learning material allows me to use my time more efficiently.	3.94	0.90	Agree
The learning material develops my analytical thinking and reasoning skills in solving problems involving fractions.	4.43	0.78	Strongly Agree
The learning material serves as supplementary materials that cater to my need as a student.	4.28	0.79	Strongly Agree
<i>Overall Mean : SD</i>	4.33 : 0.99		
<i>Verbal Interpretation</i>	Very High		

Shown in table 9, the respondents *strongly agree* that the learning material motivates them to study fractions ($M=4.78$, $SD=4.35$), and the learning material develops students' analytical thinking and reasoning skills in solving problems involving fractions. On the other hand, the respondents *agree* that the learning material allows them to use their time more efficiently ($M=3.90$, $SD=0.78$). The overall mean of 4.33 implies that MAPE as supplementary intervention material is *very useful* in developing students' mathematics performance.

Table 10. Test on the Difference of the Students' Mathematics Performance in terms of Pre-test and

Post-test.

Variables	Mean	Mean Difference	Computed t-value	p-value	Analysis
Pre-test	1.43	4.70	15.538	0.000	Significant
Post-test	6.13				

$$\alpha = 0.05$$

Shown in table 10, the test of the difference between the pre-test and post-test of students' mathematical ability in fractions shows a computed value of ($t\text{-value} = 15.538$; $p < .05$) interpreted as *Significant*. This meant that MAPE as supplementary intervention material helped to develop and improve students' mathematics performance.

Table 11. Test on the Relationship of the Students' Mathematics Performance in terms of Post-test and

Students' Perception on the use of MAPE as Supplementary Intervention Material.

Students' Perception on the use of MAPE as Supplementary Intervention Material	Student's Mathematics Performance	p-value	r-value	Degree of Correlation	Analysis
Language used	Post-test	0.568	0.061	Strong Relationship	Not Significant
Usefulness		0.452	0.080	Very Strong Relationship	Not Significant

Scale

$\pm 0.80 - \pm 1.00$

$\pm 0.60 - \pm 0.79$

$\pm 0.40 - \pm 0.59$

$\pm 0.20 - \pm 0.39$

$\pm 0.00 - \pm 0.19$

Strength

Very Strong

Strong

Moderate

Weak

Very Weak

CONCLUSION

The hypothesis stating that there is no significant difference on the level of student's performance in terms of Pre-test and Post-test was rejected. This further implies that Mathematics Ability and Performance Enhancement (MAPE) as supplementary intervention material developed students' mathematics performance.

The hypothesis stating that there is no significant relationship between the post-test and the student's perception on the use of MAPE as supplementary intervention material was accepted. This implies that students' perception on the use MAPE as supplementary intervention material has a correlation with students' mathematics performance.

RECOMMENDATIONS

1. Principals/School heads may include in their seminars, workshops, and SLAC how to create learning material for the teachers to be familiar with the different techniques thus helping their students to cope with the lessons by creating their own material.
2. Teachers may consider the use of the learning material for intervention and remedial purposes for incoming grade nine students as well as in other grade levels.
3. Students may utilize supplementary learning materials that are crafted and made by their teachers to enhance/strengthen their learning in basic mathematics.
4. Future Researchers may conduct similar studies about the use of the learning material as an intervention not just only in Mathematics but also in other subject areas may be conducted and used other variables aside from those considered in the study. Further studies may use a wider scope considering other variables not covered in this study.

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