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Effectiveness of Teacher-Made Supplemental Learning Resource Material in Mathematics for Diverse Learners

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ABSTRACT

Development of mathematics skills is one of the core targets of high-quality mathematics education. How to effectively promote mathematical skills is the focus of mathematics teaching. Relative to this, a study on the effectiveness of teacher-made supplemental learning resource material in mathematics for diverse learners was conducted. It focused on the following: development of a supplemental learning resource material in Mathematics based from the least mastered learning competencies; evaluation of jurors of the developed material; determine the effectiveness of the developed material in improving mathematics competence of three level ability groups along the strands number and number and number sense, measurement and algebra; and modifications integrated to the developed material based from the findings of the study.

The developmental-evaluative-experimental method of research was used. Two types of instruments were utilized in the study: the teacher-made pretest/posttest and evaluation rating sheet. Results of the pretest gave rise to the development of a supplemental learning resource material in Mathematics for diverse learners. It was titled: "Mathematics for Diversity" which covered the following least mastered learning competencies in Grade 7 Mathematics: "writing very large or very small numbers in scientific notation", determining the significant digits in a given situation", "solving problems involving utilities usage", and "evaluating algebraic expression for given values of the variables". Furthermore, it was found out that the use of the developed material had significant effect in improving the learning competence of Grade 7 students; hence, very effective in improving the learning competence of the students.

KEYWORDS

Effectiveness, Supplemental Learning Resource Material, Mathematics, Diverse Learners

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INTRODUCTION

The development of Mathematics skills is one of the core targets of high-quality mathematics education. How to effectively promote the transfer of mathematics skills is the focus of Mathematics teaching. It is due to the fact that everywhere in nature there are existing evidences of Mathematics and its applications. These are shown in ideas of numbers, forms, designs and symmetry, and in some constant laws governing the existence and harmonious functions of all things. Through the study of these laws, ideas and processes, that Mathematics can reveal some creative attributes in the world.

Thus, it is very important for an individual to learn and understand Mathematics and develop Mathematical skills and proficiency. There are several reasons why there is a need of doing so. First, students need to master fundamental mathematical skills in order to cope with the demands of life. Such demands include being numerically literate and gaining the tools needed for future employment, developing prerequisite skills and knowledge advance studies, and appreciating the connection of Mathematics and technology. Secondly, Mathematics is the language of other sciences and disciplines. Thirdly, it plays an important role in developing an individual's decision-making and problem-solving skills. Fourth reason is that it is an important aid in developing creativity of an individual.

According to the World Economic Forum Global Competitiveness Report (2009-2010) as cited by Giron in a speech she delivered, she stated that the Philippines need to catch up with the rest of the world. Among ASEAN countries, the Philippines places seventh in terms of quality of education system and primary education, and occupies the last position in terms of quality of Science and Mathematics education and capacity for innovation. In spite of the competence of Philippine college graduates in professional fields such as architecture, engineering, and nursing, they are underprivileged in compensation and admittance to scholarships needed for advancement. This is due to the reality that relative to the rest of the world (except Djibouti and Angola), the Philippines only had ten years of basic education; others had twelve (Giron, nd).

Such realities of the modern world require a different kind of Filipino; one who is a life-long learner, holistically developed, globally oriented yet locally grounded. With these, education transformations have long been contemplated with the beginning of a new economy-base and a growing population in need of direction. In response, the long-needed reforms, and not mere adjustments, were passed into law on May 15, 2013 which took effect on June 8, 2013. That is, Republic Act No. 10533, otherwise known as *An Act Enhancing the Philippine Basic Education System by Strengthening Its Curriculum and Increasing the Number of Years for Basic Education, Appropriating Funds Therefor and for Other Purposed*. Said law is also known as *Enhanced Basic Education Act of 2013* or the *K to 12 Law*. This law adopts as a matter of policy a complete, adequate and integrated learner-oriented education that is mindful of the diverse culture in the Philippines by including the mother tongue as a learning resource. It is also the vision of the State that the graduates of basic education will: master the basic components; gain more emotional maturity; become socially aware, proactive, and involved in public and civic affairs; be adequately prepared for work, entrepreneurship, or higher education; be legally employable with potential for better earnings, and globally competitive; and be empowered individuals who have learned, through a program that is rooted on sound educational principles and geared towards excellence, the foundations for learning throughout life, the competence to engage in work and be productive, the ability to coexist in fruitful harmony with local and global communities, the capability to engage in autonomous critical thinking, and the capacity to transform others and one's self (Estrada & Gargantiel, 2013).

Guided by these visions, one of the salient features of the program is spiral progression which is used in the K to 12 Mathematics Curriculum. In here, students learn through repeated experience of a concept; students learn best by building on their current knowledge; and students continually return to basic ideas as new subjects and concepts are added over the course of the curriculum (Estrada & Gargantiel, 2013). In the Enhanced K to 12 Basic Education Curriculum, Mathematics is one subject that pervades life at any age, in any circumstance. Thus, its value goes beyond the classroom and the school. Mathematics as a school subject, therefore, must be learned comprehensively and with much depth. Its twin goal in the basic education are critical thinking and problem solving which can be achieved with organized and rigorous curriculum content, a well-defined set of high-level skills and processes, desirable values and attributes, and appropriate tools, recognizing as well the different contexts of Filipino learners.

The birth and implementation of the K to 12 Basic Education Curriculum brings doubt and hesitation, not only to educators but also to parents and other sectors of society. They wonder if this move was the real answer to the present situation of the country. The ship (MV K-12) has sailed, and there is no more point of turning back. One thing must be considered, it must be successful and every educator has to play his/her part and find ways to make it successful. The researcher thought the developing and proposing a supplemental learning resource material is one thing that can be contributed to the implementation of the program, specifically in Mathematics. This effort could supplement the teaching-learning process in the classroom since as of the time of proposing the study, there are no available textbooks and references in the public secondary schools for Grade 7 Mathematics except for the Teacher's Guide and Learner's Guide.

According to Salandanan, self-instructional material are those which are described to be self-contained and the manner of presentation is such that the learning activities can be undertaken individually or in small groups. These materials are most effectively used in individualized instruction programs. It helps in providing remedial instruction for slow learners and enrichment materials for fast learners. Many topics can be best presented through these self-instructional materials. With the use of one, the student is allowed ample time and assistance to finish the prescribed learning activity at his own pace. The lesson will surely be enjoyed and the experience gained will be satisfying. These instructional materials may take the form of self-learning kits, a self-instructional module, a learning packet, or a do-it-yourself package (Salandanan, 2001).

A supplemental learning resource material is a reference material to be used by students and teachers to deepen love for the subject and/or for reinforcement, mastery, or enrichment of learning in different subject areas. It must help in the teaching-learning of specific concepts, skills, and values in the different learning areas and must be appropriate for pre-school, elementary or high school students. In this study, the material will come in the form of a work-text that will be used to augment the inadequacy of learning resource material in Grade 7 Mathematics. This could be used by the teacher or students or both.

The researcher is optimistic that this study is significant to those who are in the field of education such as students, teachers, school administrators, parents, and community and future researchers.

METHODOLOGY

The developmental-evaluative-experimental method of research was used in this study. First, the researcher developed the supplemental learning material based from the unmastered learning competencies of Grade 7 students in the locale of the study. In here, the three major stages of research and development

(R&D) cycle was employed such as a) planning stage, b) developing and designing stage, and c) evaluation and validation stage (Subong & Beldia, 2005).

After that, the selected jurors evaluated the material along the following criteria: content, assessment, organization and presentation, and instructional design and support. Then, a try-out or experimental method of research was used in the study. It was used since, it is unique in two important respects: it is the only type of research that directly attempts to influence a particular variable, and when properly applied, it is the best type for testing hypothesis about cause-and-effect relationships; compared to other research methods [8]. Relevant to such definition, this study put to test the effectiveness of the supplemental learning material in improving the learning competencies of the three ability groups (high, average, low) of Grade 7 students during the School Year 2013-2014 in the locale of the study. Thus, the study used the matching-only pretest-posttest control group design [9]. Such design is illustrated in the diagram below:

Treatment Group	M	O ₁	X	O ₂
Comparison Group	M	O ₁		O ₂

where:

M = subjects in each group that have been matched but not randomly assigned to the groups

O₁ = represents the pretest

X = represents the treatment implemented

O₂ = represents the posttest

With the aforementioned statements, the study then assumed that it is a developmental-evaluative-experimental study.

Since this study was an experimental one, the subjects were composed of Grade 7 students. The subjects were grouped into two: the treatment group and the comparison group.

For purposed of evaluating the supplemental learning material, jurors were selected to assess the material and at the same time give their suggestions on how to modify or improve the material.

Two kinds of instruments were used, namely: a teacher-made pretest/posttest and evaluation rating sheet. The pretest/posttest was composed of 50-item questions based from the competencies of Grade 7 Mathematics as specified in a table of specification. While the evaluation rating sheet was based from the 2009 Guidelines for Supplementary Materials (Alvar, 2010). The jurors used a 5-point Likert Scale to evaluate the material, such as

4.51 – 5.0	-	To a Very Great Extent	1.51 – 2.50	-	To Some Extent
3.51 – 4.50	-	To a Great Extent	1.00 – 1.50	-	To the Least Extent
2.51 – 3.50	-	To a Moderate Extent			

Meanwhile, the effectiveness of the proposed supplemental learning material was determined using a scale based from the percentage of increase in the performance of the subjects in the posttest as compared with their pretest. The scale is given below:

<u>% of Increase</u>		<u>Interpretation</u>
80.51 – above	-	Extremely Effective
60.51 – 8.50	-	Very Effective
40.51 – 60.50	-	Somewhat Effective
20.51 – 40.50	-	Slightly Effective
0.00 – 20.50	-	Not at All Effective

A permission from the Schools Division Superintendent of DepEd-Division of Camarines Norte was sought before the conduct of the study. The instruments were personally retrieved, tallied and tabulated by the researcher. The following statistical tools were employed: frequency count and percentage technique, weighted mean and t-test for independent data.

RESULTS

It is a reality that during the implementation of Grade 7 in the secondary level, there were so many problems meet by administrator, teachers, students and parents, among the few. One of which is the lack of learning and instructional materials, taking into consideration the changes in the strands and core competencies of the subjects being offered in Grade 7, just like Mathematics which was somewhat different from the one offered in Basic Education Curriculum (BEC). With these realities, schools were encouraged to localize the curriculum to respond to their teaching-learning needs; enrich it without sacrificing the established content and performance standards and competencies to make the curriculum responsive to their needs.

Since there are no available instructional material, if ever there is, it came in the late quarter of SY 2012-2013, so both the students and teachers were not able to utilize them. As such, it is a disheartening fact that at the end of that school year many Grade 7 students were not able to master the learning competencies of the Grade 7 Mathematics. It became a realization that, as a teacher, one has to be innovative and creative so that the needs of the learners will be met. With that the idea of developing a supplemental resource material in Grade 7 Mathematics for diverse learners came in.

The Developed Supplemental Learning Resource Material for Grade 7 Mathematics for Diverse Learners

In order to identify the unmastered competencies of Grade 7 students in Grade 7 Mathematics along the strands number and number sense, measurement, and patterns and algebra, the researcher administered a pretest in Grade 7 Mathematics among the Grade 7 students of Tuaca High School during the opening of School Year 2013-2014. From that pretest, it was found out that majority of the students were not yet prepared for the competencies in Grade 7 Mathematics. Table 1 shows the summary of the unmastered learning competencies along the strand number and number sense.

Table 1. Unmastered Learning Competencies in Number and Number Sense (n=66)

Learning Competency	Treatment Group (n=33)		Comparison Group (n=33)		Combined (n=66)		Rank (1=highest)
	No. of Correct Responses	PL (%)	No. of Correct Responses	PL (%)	No. of Correct Responses	PL (%)	
1. Uses Venn Diagram to represent set, subsets, and set operations (3)	2	6.06	8	24.24	10	15.15	5
2. Finds the union, intersection and complement of the set of real numbers and its subset (1)	9	27.27	7	21.21	16	24.24	1
3. Performs operation on rational numbers and illustrate their properties (2, 5, 13)	4	12.12	6	18.18	10	15.15	5
4. Perform fundamental operations on integers: addition, subtraction, multiplication and division (4)	5	15.15	3	9.09	8	12.12	8
5. Describes and represents real-life situations which involves integers, square roots of rational and irrational numbers (14)	3	9.09	9	27.27	12	18.18	3
6. Solves problems involving real numbers (7, 8)	4	12.12	6	18.18	10	15.15	5
7. Describes the principal root and tells whether they are rational or irrational (6, 9)	7	21.21	7	21.21	14	21.21	2
8. Solves problems involving square roots (15)	4	12.12	5	15.15	9	13.64	7
9. Determines the significant digits in a given situation (10, 11)	3	9.09	3	12.12	6	9.09	9.5
10. Writes very large and very small numbers in scientific notation (12)	4	12.12	2	6.06	6	9.09	9.5

Results showed that there is a great need to master the learning competencies in number and number sense because these are fundamental knowledge and skills needed in future studies of Mathematics.

Table 2 shows the summary of unmastered learning competencies along measurement. Findings show that the students in the locale of the study have not mastered yet the learning competencies of the strand measurement that was below the expected performance level of 75% by the DepEd.

Table 2. Unmastered Learning Competencies in Measurement (n=66)

Learning Competency	Treatment Group (n=33)		Comparison Group (n=33)		Combined (n=66)		Rank (1=highest)
	No. of Correct Responses	PL (%)	No. of Correct Responses	PL (%)	No. of Correct Responses	PL (%)	
1. Estimates or approximates the measures of quantities (16)	9	27.27	7	21.21	16	24.24	3
2. Use appropriate instrument to measure angle, time and temperature (17)	8	24.24	4	12.12	12	18.18	6
3. Convert measurement from one unit to another (18, 19)	4	12.12	10	30.30	14	21.21	4
4. Solves problems involving volume or capacity (20, 24)	5	15.15	8	24.24	13	19.70	5
5. Solve problem involving volume or capacity (20, 24)	5	15.15	8	24.24	13	19.70	5
6. Solves problem involving time(21)	2	6.06	8	24.24	10	15.15	8
7. Solves problem involving temperature (22)	9	27.27	9	27.27	18	27.27	2
8. Solves problems involving utilities usage (25)	10	30.30	9	27.27	19	28.79	1

Meanwhile, it was revealed that the learning competency in patterns and algebra that had the least number of correct responses was “*derives the law of exponent*” with nine out of 66 or PL=13.64%.

Based from the above findings on unmastered learning competencies in Grade 7 Mathematics, a supplemental learning resource material was developed and proposed. This was called “*Mathematics for Diversity 7*”- A Supplemental Learning Resource Material in Grade 7 Mathematics for Diverse Learners. The said material was composed of three sets of loosely packed materials which are arranged by topic according to the need of the learners. Each of the high ability group, average ability group and low ability group of learners has separate material by group. The material was packaged in such a way that it would be handy and convenient to facilitate effective learning. Each set of material contains the same discussion of the content topic and differed only on the activities depending upon the learning ability of the user. This was done to ensure that all learners would be able to appreciate Mathematics and do not treat the subject as a subject for the genius only or to the “wizards”.

Thus, Volume 1 of the material is all about number and number sense, which has two packages. Package A covers topics on sets such as Basic Ideas of Sets, Union and Intersection of Sets, Complement of a Set, and Problems Involving Sets. Learners have to be exposed to these topics so that they would be able to solve certain problems of counting by performing certain operations on sets to form new sets. Package B consists of topics on the Set of Real Numbers, Rational Numbers, Principal Roots and Irrational Numbers and Problems Involving Real Numbers.

Meanwhile, Volume 2 dealt with the strand Measurement and it has only one package which contains topics/learning competencies on Systems of Measurement and Measures and Measuring Devices. While Volume 3 is all about the strand Algebra consists of the topics/learning competencies such as Algebraic Expressions, Polynomials, and Equations and Inequalities. Each package is consists of activity cards depending upon the ability group who would use the material.

The students together with the teacher personally check their works by comparing their work with the answers on the Answer Card. Each answer card has an assigned number and letter on top as reference. The number indicates the topic number while the letter is the level or ability group who uses the Activity Card. And, in order to facilitate monitoring and evaluation of the students' performance, each one of them had a "Student Primer" where they write notes, solutions and answers to the activities. It is also used to record their respective scores.

Evaluation of the Supplemental Learning Resource Material by the Jurors

Results showed that the developed supplemental learning resource material in Grade 7 Mathematics has to undergo further evaluation and validation due to some limitations of the research study and this was affirmed by Alvar [9]. Table 3 shows the summary of evaluation of the developed instructional material.

Table 3. Summary of Evaluation of the Developed Supplemental Learning Resource Material

Criteria	Weighted Mean	Interpretation
Content	3.40	To a Moderate Extent
Equity and Accessibility	3.74	To a Great Extent
Assessment	3.82	To a Great Extent
Organization and Presentation	3.88	To a Great Extent
Instructional Design and Support	2.88	To a Great Extent
Grand Mean	3.54	To a Great Extent

Effectiveness of the Proposed Supplemental Learning Resource Material

It was hypothesized in this study the use of the developed supplemental learning resource material was not significantly effective in improving the competency of the three ability groups of Grade 7 students. Table 4 shows the comparison of the pretest and posttest scores of the students.

Table 4. Comparison of the Pretest and Posttest Scores

Compared Groups	Mean	Mean Diff	df	SD	t-value	Critical Value	Decision
1. Pretest							
Treatment	10.97	0.36	64	4.51	0.44	1.998	Accept Ho
Comparison	11.33			1.55			
2. Posttest							
Treatment	36.82	7.43	64	5.34	4.09	1.998	Reject Ho
Comparison	29.39			8.96	*		

*significant at $\alpha=0.05$

It is shown in the table that the computed t-value of 0.44 in the pretest is lesser than the critical t-value of 1.998 at 0.05 level of significance with $df = 64$. This means that the mean difference of 0.44 in the pretest scores is not significant and can be attributed to chance. Meanwhile, the t-value of 4.09 in the posttest is greater than the critical t-value of 1.998 at 0.05 level of significance with $df = 64$. Therefore, there is significant difference in the posttest scores of the treatment and comparison groups. This difference is manifested by the mean difference of 7.43 in the posttest scores. This implies that the use of the developed learning resource material in the treatment group has significant effect in improving the learning competence of Grade 7 students in the locale of the study as compared to the comparison group. On the other hand, Table 5 summarizes the comparison of posttest scores of the three ability groups.

Table 5. Comparison of the Posttest Scores of the Treatment Group by Ability

Compared Groups	Mean	Mean Diff	df	SD	t-value	Critical Value	Decision
High Ability Group							
Treatment	42.63	4.8	12	3.20	1.21	2.179	Accept Ho
Comparison	37.83			10.70			
Average Ability Groups							
Treatment	36.28	5.54	35	3.23	3.24*	2.030	Reject Ho
Comparison	30.74			6.53			
Low Ability Groups							
Treatment	31.57	11.69	13	5.77	5.23*	2.160	Reject Ho
Comparison	19.88			2.47			

*significant at $\alpha=0.05$

The table shows that when grouped according to ability, the computed t-value of 1.21 in the high ability group is lesser than the critical t-value of 2.179 at 0.05 level of significance with $df=12$. And, it means that the mean difference of 4.8 is not significant for the high ability group. Hence, the computed t-value of 3.24 was greater than the critical t-value of 2.030 at 0.05 level of significance with $df=35$. It means that the mean difference of 5.54 is significant for the average ability group. And, the computed t-value of 5.23 in the low ability group is greater than the critical t-value of 2.160 at 0.05 level of significance with $df=13$. And, it means that the mean difference of 11.69 is significant for the low ability group. Furthermore, Table 6 summarizes the data on the effectiveness of developed supplemental learning resource material in improving the learning competencies of Grade 7 students.

Table 6. Effectiveness of the Developed Supplemental Learning Resource Material

Strand	Pretest PL	Posttest PL	Increase/ Decrease	Interpretation
Number and Number Sense	12.73	77.78	65.05	Very Effective
Measurement	18.48	63.64	45.16	Somewhat Effective
Algebra	27.90	58.33	30.43	Slightly Effective

Along number and number sense, the mean percentage increase of 65.05% interpreted as very effective. This is evidenced by the mean performance level of 12.73 in the pretest and 77.78 in the posttest. While the increase of 45.16 in the PL indicated that the material was somewhat effective in improving the competence of the subjects along the strand measurement. And, it was observed that along algebra, the average increase in PL of 30.43 and this is interpreted as slightly effective. This is supported by the mean of 27.90 in the pretest and 58.33 in the posttest.

Modifications Integrated to the Supplemental Learning Resource Material

In order to facilitate the usability and effectiveness of the developed supplemental learning resource material, the researcher integrated several modifications based from the findings of the study. The following were the modifications integrated: enrich content based from the prescribed curriculum, included items that develop HOTS, provide activities that promote data gathering and manipulation, added pretest and posttest for each package, review evaluation part of the material, and revise material and integrate solution to findings.

CONCLUSION

Based from the findings of the study, it was concluded that the developed supplemental learning resource material in Grade 7 for diverse learners have to undergo further evaluation and validation due to some limitations of the research in terms of content, assessment, organization and presentation, and instructional design and support. It was also concluded that the use of the developed material had increased the performance level of the students; hence very effective in improving subjects' competency in Grade 7 Mathematics.

Based from the above-mentioned findings and conclusion, the following recommendations were given: Secondary math teachers should make a way on how they could bridge the gap on the foundation elementary and secondary Mathematics. Teachers may opt to develop learning material on the strand's geometry and probability and statistics. Activities and exercises that promote the development of HOTS should be integrated. Further evaluation and validation should be conducted in order to establish the validity and reliability of the material. More effort should be extended to improve students' competence in Mathematics in order for them to become competent and competitive. Revisit the implementation of the curriculum to determine improvements or enhancements of the program. Policy-makers in education should consider drafting a special provision on how to accommodate diverse learners, and future researchers may conduct test of reliability and validation of the material to other subjects in different locale.

REFERENCES

- Giron, P. Building the Philippines every Filipino deserves, a speech delivered in a Forum on Enhance Basic Education Curriculum, Department of Education
- Republic Act No. 10533, Enhanced Basic Education Act of 2013,
www.officialgazette.gov.ph/2013/0515/republic-act-no-10533
- Estrada, J. & Gargantiel, K. V. (2013). K to 12: RA No. 10533 and Relevant Education Policies, Vibal Group, pp. 3-4
- Estrada, J. & Gargantiel, K. V. (2013). K to 12: RA No. 10533 and Relevant Education Policies, Vibal Group, pp. 4-5
- Salandanan, G.G. (2001). Teacher Education Journal, Katha Publishing Co. Inc., p. 121
- Department of Education. (2009). Guidelines for supplementary materials (call for submission of supplementary materials), December 2009
- Subong, P.E. & Beldia, M. D. (2005). Statistics for Research, Rex Book Store, Inc., p. 147
- Fraenkel, J. R. & Wallen, N. E. (2008). How to Design and Evaluate Research in Education, 7th Edition, McGraw-Hill Companies, Inc., p. 265
- Alvar, J. G. (2010). Development of teachers' support materials for teaching solving word problem in college algebra using Microsoft-excel program, The Trailblazer, Philippine Normal University, Agusan Campus.