

WEST VISAYAS STATE UNIVERSITY
COLLEGE OF EDUCATION
GRADUATE SCHOOL
Iloilo City

MATHEMATICAL HABITS OF MIND, SELF-EFFICACY, AND ACADEMIC PERFORMANCE
OF TOP SCORERS IN MATHEMATICS COMPETITION

A Thesis Presented to the
Faculty of the Graduate School
College of Education
West Visayas State University
La Paz, Iloilo City

In Partial Fulfilment
of the Requirements for the Degree
Master of Arts in Education
(Elementary Mathematics)

by

Jose Michael C. Gaje

June 2022

WEST VISAYAS STATE UNIVERSITY
COLLEGE OF EDUCATION
GRADUATE SCHOOL
Iloilo City

APPROVAL SHEET

A Thesis for the Degree
Master of Arts in Education
(Elementary Mathematics)

by

Jose Michael C. Gaje

Approved by the Research Committee:

ROSEMARIE G. FELIMON, Ph.D., Chairperson

ROBERTO G. SAGGE JR., Ph.D., Member

KIM S. ARCENA, Ed.D., Outside Expert

JONATHAN C. GLORIAL, Ph.D., Adviser

RICKY M. MAGNO, Ph.D.
Dean

June 2022

WEST VISAYAS STATE UNIVERSITY
COLLEGE OF EDUCATION
GRADUATE SCHOOL
Iloilo City

Gaje, Jose Michael C. *"Mathematical Habits of Mind, Self- Efficacy and Academic Performance of Top Scorers in Mathematics Competition"*, Unpublished Master's Thesis. Master of Arts in Education (Elementary Mathematics), West Visayas State University, Iloilo City, June 2022.

Abstract

This study aimed to determine the levels of learners' self-efficacy and mathematical habits of mind (MHoM) and academic performance and the relationships of these variables. The respondents of this study were the 2020 Metrobank-MTAP-DepEd Math Challenge Division Elimination top scorers. The instruments used in this study were the (1) Non-routine Problem Solving, (2) Reflecting and Self-checking of Learning ,(3) and Self- Efficacy Rating Scale for habits of mind MHoM. Mean, standard deviation, and Spearman's Rank Correlation were used to answer the research problems and hypothesis posted in the study. The significance level was set at 0.05. The study revealed that efficacy of the top scorers was "Moderately High" and their MHoM was "Satisfactorily-developed". In five components of MHoM , the habit of reflecting and self-checking of learning is "Slightly-developed". On the other hand, the habit of searching for patterns, linking ideas or representation, reasoning deductively and through experiments fall under "Satisfactorily-developed". In addition, there were significant relationships of self-efficacy to searching for patterns, linking ideas and representation, reflecting and self-checking of learning. The interrelatedness or relationship of MHoM and self-efficacy signifies that if the MHoM is very strongly-developed the higher the self-efficacy level and vice versa. This further tells that the

WEST VISAYAS STATE UNIVERSITY
COLLEGE OF EDUCATION
GRADUATE SCHOOL
Iloilo City

better the habit of searching for patterns of a learner, the better the self-efficacy. This is true to the habit of linking ideas and representation, habit of reasoning deductively and through experiments, and habit of reflecting and self-checking of learning. Learners should try exploring other possible ways to solve a problem and not be contented with solving it with only one strategy. Teachers should likewise provide opportunities for students to be exposed to problems that may be solved in many ways. The teacher must also acknowledge that learning is not only influenced by cognitive factors alone but by affective factors too. Teachers can enhance the level of learner's efficacy through various feasible teaching techniques. As a consequence, providing abundance of experiences and building positive beliefs in learners are essential for them to develop the sense of efficacy.

WEST VISAYAS STATE UNIVERSITY
COLLEGE OF EDUCATION
GRADUATE SCHOOL
Iloilo City

TABLE OF CONTENTS

	Page
Title Page	i
Approval Sheet	ii
Acknowledgment	iii
Abstract	vii
Table of Contents	x
List of Figures	xiii
List of Tables	xiv
List of Appendices	xv
Chapter	
1 INTRODUCTION TO THE STUDY	1
Background of the Study	2
Theoretical Framework of the Study	6
Statement of the Problem	8
Statement of the Hypothesis	8
Definition of Terms	8
Delimitation of the Study	12
Significance of the Study	13

WEST VISAYAS STATE UNIVERSITY
COLLEGE OF EDUCATION
GRADUATE SCHOOL
Iloilo City

2	REVIEW OF RELATED LITRATURE	17
	Mathematics Habits of Mind	17
	Self-Efficacy	25
	Academic Performance	30
	Summary	39
3	RESEARCH DESIGN AND METHODOLOGY	42
	Research Design	42
	Methodology	43
	The Respondents	43
	The Instruments	45
	Data Collection Procedure	48
	Data Analysis Procedure	50
4	RESULTS AND DISCUSSIONS	51
	Descriptive Data Analysis	51
	Inferential Data Analysis	53
5	SUMMARY, CONCLUSION, IMPLICATIONS, AND RECOMMENDATIONS	56
	Summary of the Problem, Method, and Findings	56
	Conclusions	60
	Implications	62
	For Theory	62
	For Practice	66

WEST VISAYAS STATE UNIVERSITY
COLLEGE OF EDUCATION
GRADUATE SCHOOL
Iloilo City

Recommendations	69
REFERENCES	73
APPENDICES	85

WEST VISAYAS STATE UNIVERSITY
COLLEGE OF EDUCATION
GRADUATE SCHOOL
Iloilo City

LIST OF FIGURES

Figure		Page
1	Conceptual Framework Showing Interrelationship of Mathematical Habits of Mind, Self-Efficacy and Academic Performance	7
2	Distribution of Participants in the Province of Iloilo	44
3	Administration of the Data Gathering Instruments in the Different Elementary Schools in the Schools Division of Iloilo	49

WEST VISAYAS STATE UNIVERSITY
COLLEGE OF EDUCATION
GRADUATE SCHOOL
Iloilo City

LIST OF TABLES

Table	Page
1 A Five-point Scale in Determining the Over-all and Specific Levels of Mathematics Habits of Mind (MHoM) of learners	45
2 A Five-point Scale in Determining the Levels of Self-Efficacy of Learners	47
3 A Guide in Categorizing Learners' Academic Performance	
4 A Guide in Categorizing Learners' Academic Performance (Excellence Award)	
5 Levels of Learner's Math Self-Efficacy and Mathematical Habits of Mind (MHoM)	53
6 Strength of Relationship of Learner's Mathematical Habits of Mind, Self-Efficacy, Academic Performance and Among the Five Components of Mathematics Habits of Mind (MHoM)	55

WEST VISAYAS STATE UNIVERSITY
COLLEGE OF EDUCATION
GRADUATE SCHOOL
Iloilo City

LIST OF APPENDICES

Appendix		Page
A	Letter to the Validators	86
B	Letter to the Schools Division Superintendent	90
C	Letter to the Parents/Respondents/Parents' Consent	92
D	Mathematical Habits of Mind Instrument (Part 1)	96
E	Mathematical Habits of Mind Instrument (Part 2)	99
F	Self-Efficacy Rating Scale Instrument	101
G	Assessment of Mathematical Habits of Mind Rubrics	104
H	SPSS Results	110
I	Result of the 2020 Math Challenge Division Elimination	116
J	Guide in Categorizing Learners' Academic Performance	120

WEST VISAYAS STATE UNIVERSITY
COLLEGE OF EDUCATION
GRADUATE SCHOOL
Iloilo City

75

- Camarista, G. G. (2012). Creativity, self-efficacy, anxiety, and problem-solving performance of the potential mathematically gifted. Unpublished Doctoral Dissertation. West Visayas State University, Iloilo City, Philippines.
- Cohen, J. (1992). A power primer. *Psychological Bulletin*, *112*(1): 155 – 159.
- Cuoco, A. & Levasseur, K. (2003). Mathematical Habits of Mind. In The National Council of Teachers of Mathematics (NCTM) (2003). *Teaching Mathematics through Problem Solving: Grades 6-12*. NCTM, ISBN 0-87353-541-3, 27-37.
- Cuoco, A. (2008). Introducing Extensible Tools in Middle- and High-School Algebra. In C. Greenes (Ed.), *Algebra and Algebraic Thinking in School Mathematics: 2008 Yearbook of the National Council of Teachers of Mathematics (NCTM)*. Reston, VA: NCTM, 51–62.
- Cuoco, A., Goldenberg, E. P., & Mark, J. (1996). Habits of mind: An organizing principle for mathematics curricula. *Journal of Mathematical Behavior*, *15*(4), 375–402.
- Cuoco, A., Goldenberg, E. P., & Mark, J. (2010). Contemporary curriculum issues: Organizing a curriculum around mathematical habits of mind. *Mathematics Teacher*, *103*(9), 682–688.
- Cuoco, A., Matsuura, R., Piecham, M.B., Stevens, G., & Sword, S. (2013). Mathematical habits of mind for teaching: using language in algebra classrooms. *The Mathematics Enthusiast*, ISSN 1551-3440, *10*(3), 735-776.
- Department of Education (2015). *K to 12 Curriculum Guide: Mathematics*. Pasig City: DepEd Complex, Meralco Avenue.

WEST VISAYAS STATE UNIVERSITY
COLLEGE OF EDUCATION
GRADUATE SCHOOL
Iloilo City

76

DepEd Order No. 73, s. 2012. *Guidelines on the Assessment and Rating of Learning Outcomes under the K to 12 Basic Education Curriculum.*

Dewey, J. (1916). *Democracy and education: An introduction to the philosophy of education.* New York, NY: The Free Press.

Dewey, J., & Small, A. W. (1897). *My pedagogic creed & the demands of sociology upon pedagogy.* New York, NY: E.L. Kellogg.

DiMatteo, R. W. & Lester, F. K. (2010). The role of problem solving in the secondary school mathematics classroom. In J. Lobato & F. Lester (Eds.). *Teaching and learning mathematics: Translating research for secondary teachers.* Reston, VA: National Council of Teachers of Mathematics, 7-12.

Dreyfus, T. & Eisenberg, T. (1990). Conceptual calculus: fact or fiction? *Teaching mathematics and its application*, 9(2), 63-66.

Duckworth, E. (1996). *The having of wonderful ideas & other essays on teaching & learning* (2nd ed.). New York, NY: Teachers College Press.

Dunlosky, J., & Rawson, K. A. (2012). Overconfidence problems produces underachievement: Inaccurate self-evaluations undermine students' learning and retention. *Learning and Instruction*, 22, 271-280.

Encio, K. J. (2015). *Mathematical habits of mind in solving non-routine problems and academic performance of grade 9 students.* Unpublished master's thesis, West Visayas State University, Iloilo City, Philippines.

WEST VISAYAS STATE UNIVERSITY
COLLEGE OF EDUCATION
GRADUATE SCHOOL
Iloilo City

77

- Encio, K.J. (2013). Joining forces of math and virtue. *The Infinity*, 3(1), ISSN# 2244-3290, 17.
- Estabrook, R. and Findley, D. (1991). *Teacher evaluation: Curriculum and instructional considerations*. Retrieved from ERIC database. (EJ440379)
- Farillon, S. J. B. (2008). *Chinese school pupils' self-efficacy and attitudes towards mathematics: Their relationship to mathematics achievement*. Unpublished master's thesis, West Visayas State University, Iloilo City, Philippines.
- Ferrini-Mundy, J., Senk, S., McCrory, R., & Schmidt, W. (2005, May). *Measuring secondary school mathematics teachers' knowledge of mathematics for teaching: Issues of conceptualization and design*. Working session at the International Committee on Mathematics Instruction Study 15 Meeting, Lindoia, Brazil.
- Fetsco, T. & Soby, B. (2014). Metacognition: An Introduction. *Arizona GEAR UP Research in Practice Series*, 3(1), Spring 2014.
- Ford, M. I. (1994). *Teachers' beliefs about mathematical problem solving in the elementary school*. *School Science and Mathematics*, 94(6), 314-323.
- Fraenkel, J. & Wallen, N. (2009). *How to design and evaluate research in education*. New York: McGraw-Hill Companies, Inc.
- Garner, R., & Alexander, P. A. (1989). Metacognition: Answered and unanswered questions. *Educational Psychologist*, 24(2), 143-158.
- Gilfeather, M. & del Regato, J. (1999). Routine and non-routine problem solving. *Pentathlon institute*, 20-22.

WEST VISAYAS STATE UNIVERSITY
COLLEGE OF EDUCATION
GRADUATE SCHOOL
Iloilo City

78

Glaserfeld, E. (1989). Cognition, construction of knowledge, and teaching. *Synthese*, *80*(1), 121-140.

Glorial, J. (2016). *The chronicles of peak performers in intensive mathematics program: survey and narrative inquiry*. Unpublished Doctoral Dissertation. West Visayas State University, Iloilo City, Philippines.

Goldenberg, E. P., Mark, J., & Cuoco, A. (2010). Contemporary curriculum issues: An algebraic-habits-of-mind perspective on elementary school. *Teaching children mathematics*, *16*(9), 548–556.

Goldenberg, P. (2009, January). *Mathematical habits of mind and the language-learning brain: Algebra as a second language*. Paper presented at an AMS-MAA-MER Special Session on Mathematics and Education Reform, Joint Mathematics Meetings, Washington, DC. Retrieve on April 29, 2014, <http://www.math.utep.edu/Faculty/kienlim/hom.html>.

Guarian, M., Stevens, K., & Daniels, P. (2009). *Successful single-sex classrooms: A practical guide to teaching boys & girls separately*. San Francisco: Jossey-Bass.

Hardy, G. H. (1940). *A mathematician's apology*. New York, NY: Cambridge University Press.

Harel, G. (2007). The DNR system as a conceptual framework for curriculum development and instruction. In R. Lesh, J. Kaput, E. Hamilton (Eds.). *Foundations for the future in mathematics education* (pp. 263-280). Mahwah, NJ: Lawrence Erlbaum Associates.

WEST VISAYAS STATE UNIVERSITY
COLLEGE OF EDUCATION
GRADUATE SCHOOL
Iloilo City

79

- Harel, G. (2008). What is mathematics? A pedagogical answer to a philosophical question. In B. Gold & R. Simons (Eds.), *Current issues in the philosophy of mathematics from the perspective of mathematicians*. Washington, DC: Mathematical American Association.
- Higgins, K. M. (1997). The effect of long instruction in mathematical problem solving on middle school students' attitudes, beliefs and abilities. *Journal of Experimental Education, 66*(1), 5-24.
- Hill, H. C., Rowan, B., & Ball, D. L. (2005). Effects of teachers' mathematical knowledge for teaching on student achievement. *American educational research journal, 42*(2), 371-406.
- Hill, H. C., Sleep, L., Lewis, J. M., & Ball, D. L. (2007). Assessing teachers' mathematical knowledge: What knowledge matters and what evidence counts? In F. K. Lester (Ed.), *Second handbook of research on mathematics teaching and learning* (vol. 1, pp. 111-155). Charlotte, NC: Information Age Publishing.
- Horizon Research, Inc. (2000). *Inside the classroom observation and analytic protocol*. Retrieved on April 29, 2014, <http://www.horizon-research.com/instruments/clas/cop.php>
- Jackson, Allyn. (2001). Interview with Arnold Ross. *Notices of the AMS, 48*(7), 691-698.
- Krulik, S. & Rudnick. J. (1996). *The new sourcebook for teaching reasoning and problem solving in junior and senior high schools*. Boston, MA: Allyn and Bacon.
- Kuhn, D. (2005). *Education for thinking*. Cambridge, MA: Harvard University Press.

WEST VISAYAS STATE UNIVERSITY
COLLEGE OF EDUCATION
GRADUATE SCHOOL
Iloilo City

80

- Leikin, R. (2007). *Habits of mind associated with advanced mathematical thinking and solution spaces of mathematical tasks*. In the Proceedings of the Fifth Conference of the European Society for Research in Mathematics Education (pp. 2330-2339). Larnaca, Cyprus.
- Lester Jr., F. (2013). Thoughts About Research on Mathematical Problem-Solving Instruction. *The Mathematics Enthusiast*, ISSN 1551-3440, 10(1&2), 245-278.
- Libutaque, M. (2011). *Mathematical investigation (mi) approach in teaching algebra in the development of problem-solving and proof-writing skills and mathematical habits of mind*. Unpublished Doctoral Dissertation. West Visayas State University, La Paz, Iloilo City.
- Lim, K. (2013). *A collection of lists of mathematical habits of mind*. University of Texas at El Paso.
- Lim, K. H. (2009, January). *Undesirable habits of mind of pre-service teachers: Strategies for addressing them*. Paper presented at an AMS-MAA-MER Special Session on Mathematics and Education Reform, Joint Mathematics Meetings, Washington, DC. PowerPoint available at <http://www.math.utep.edu/Faculty/kienlim/hom.html>.
- Limjap, A. (1996). *A constructivist- based instructional systems design for undergraduate discrete mathematics*. Unpublished Doctoral Dissertation, De La Salle University, Manila, Philippines.

WEST VISAYAS STATE UNIVERSITY
COLLEGE OF EDUCATION
GRADUATE SCHOOL
Iloilo City

82

- Polya, G. (1954b). *Mathematics and plausible reasoning: Patterns of plausible inference: Vol. 2*. Princeton, NJ: Princeton University Press.
- Polya, G. (1962). *Mathematical discovery: On understanding, learning, and teaching problem solving* (Vol. 1). New York, NY: John Wiley.
- Pressley, M., & Ghatala, E. S. (1990). Self-regulated learning from text. *Educational Psychologist, 25*(1), 19-33.
- Ryle, G. (1949). *The concept of mind*. London: Hutchison.
- Sagge, R. Jr. (2014). *Music: Effects on students' achievement, habits of mind, test anxiety, and disposition as bases for the development of music-enhanced mathematics program*. Unpublished Doctoral Dissertation. West Visayas State University, Iloilo City, Philippines.
- Schmidt, W., Huang, R., & Cogan, L. (2002, Summer). A coherent curriculum: The case of mathematics. *American Educator, 26*(2), 10–26, 47. Retrieved on April 29, 2014, <http://www.aft.org/pdfs/americaneducator/summer2002/curriculum.pdf> on April 20, 2014.
- Schoenfeld, A. H. (1992). *Learning to think mathematically: Problem solving, metacognition, and sense making in mathematics*. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning*. New York: Macmillan, 334-370.
- Schön, D. (1983). *The reflective practitioner: How professionals think in action*. London: Temple Smith.

WEST VISAYAS STATE UNIVERSITY
COLLEGE OF EDUCATION
GRADUATE SCHOOL
Iloilo City

83

Selden, A., & Selden, J. (2005). Perspectives on advanced mathematical thinking. *Mathematical thinking and learning*, 7, 1-13.

Selden, J., & Selden, A. (2008). *Consciousness in enacting procedural knowledge*. Proceedings of the conference on research in undergraduate mathematics education (2008). Retrieved April 15, 2014, <http://cresmet.asu.edu/crume2008/Proceedings/Proceedings.html>.

Shulman, L. (1997). Knowledge and teaching: Foundations of the new reform. *Harvard educational review*, 57(1), 1-22.

Stein, M. K., Boaler, J. & Silver, E. A. (2003). Teaching mathematics through problem solving: Research perspectives. In H. L. Schoen & R. I. Charles (Eds.), *Teaching mathematics through problem solving: Grades 6-12* (pp. 245–256). Reston, VA: National Council of Teachers of Mathematics.

Tall, D. (1991). *Advanced mathematical thinking*. Kluwer Academic Publisher, Holland.

Verschaffel, L., De Corte, E., Lasure, S., VanVaerenbergh, G., Bogaerts, H.& Ratinckx, E. (1999). Learning to Solve Mathematical Application Problems: A Design Experiment with Fifth Graders. *Mathematical thinking & learning*, 1(1), 195-229.

Vygotsky, L. (1978). *Mind in society: the development of higher mental processes*. Cambridge, MA: Harvard University Press.

Watson, A. and Mason, J. (2001). Getting students to create boundary examples. *MSOR connections*, 1(1), 9-11.

Zazkis, R., & Leikin, R. (2010). Advanced mathematical knowledge in teaching practice: Perceptions of secondary mathematics teachers. *Mathematical thinking and learning, 12*(4), 263-281.