Students' Workload and Mathematical Anxiety Level under the New DepEd K to 10 Curriculum of the Philippines

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ABSTRACT

The study tackles the workload of the students and how it affects their behavior towards learning Mathematics subject. The researchers utilized the descriptive-correlational design and triangulation process. There were three schools included in this study which were randomly selected. The respondents from these schools were purposively taken to isolate the variables on teacher-factor, monthly family income, and anxiety. They were the top 15 performing students from Grades 1 to 10 (n = 300). The researchers utilized a standardized questionnaire and employed the Mann-Whitney U test and Spearman's rank-order correlation. The study revealed that the mathematical anxiety of the students was increasing and at its peak in Grade 9. An abrupt and significant change of their mathematical anxiety was depicted between Grades 5 and 6; and Grades 7 and 8. An overloaded curriculum and introduction of new subjects which were not adequately pre-spiraled were identified as causes of students' growing fear towards learning Mathematics.

Keywords: K to 10 curriculum, math anxiety, math spiral curriculum, student workload.

INTRODUCTION

Mathematical anxiety, according to Geist (2010), refers to the "fear of Mathematics" or "negative attitude" towards learning Mathematics. It is a state where a person feels anxious or uneasy whenever he or she is faced with Mathematics-related situations (Belbase, 2013; Smith, 1997).

In the early stages of learning Mathematics, one's attitude may be highly positive due to the naturalness of mathematical concepts on counting, number sense, colors and shapes (Jordan, Kaplan, Locuniak & Ramineni, 2007). Nonetheless, as the level of abstraction of mathematical concepts gets higher, it may take more than just positive attitude to grasp the gist of the subject matter. Thus, the researchers believe that as the child steps into the path of mathematical learning, he or she meets some points along the way that the mathematical level of abstraction becomes distasteful to him or her. It is in this context that the researchers wish to find out what point in time when the child balks in his or her mathematical journey. Where this point in time exists, the researchers would also be interested to find out what factors could these be attributed to.

Several works by scholars have determined many causes of mathematical anxiety which include previous negative classroom experiences (Stodolsky, 1985), parental influences (Scarpello, 2007), difficulty of the subjects or workload (Jackson & Leffingwell, 1999) and teachers' behavior (Catlioglu, Birgin, Costu, & Gurbuz, 2009). Research of Bakker, Heuvel-Panhuizen,

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and Robitzsch (2014) found out that students' interest in Mathematics tended to lessen or decline as they stepped up to the higher grade level. Jackson and Leffingwell (1999) discovered that 16% of students had their traumatic experience in Mathematics as early as Grades 3 and 4. Likewise, Scarpello (2007) claimed that mathematical anxiety could develop in Grade 4 and could peak in middle school and high school. Ahuja (2006) also noted that students' anxiety in Mathematics in the United States was increasing from Grades 4 to 8.

Meanwhile, Hennesy (2007) also observed that her Kindergarten pupils were very enthusiastic, creative, and eager to learn but three years later, she found that they turned to be passive learners and unwilling to take risks and lacked the curiosity they once had. The US Department of Education also identified that 81% of Grade 4 learners had a positive or strongly positive attitude towards Mathematics, but only 35% of the learners had the same attitude and interest in the subject by the time they reached Grade 4 (cited in Mann, 2009). Several studies further indicated that decline in attitude towards Mathematics was usually more prevalent among Grades 6-7 students (Haladyna & Thomas; Yamamoto et al.; Parsons et al.; as cited in Eccles, 1984). Moreover, Wigfield and Meece (1988) revealed that Grade 9 students were found to manifest mathematical anxiety the most.

Mathematical anxiety can be manifested in various ways. Smith (1997) stated that students with mathematical anxiety tend to panic and avoid Mathematics classes, and even if they do attend their classes, they become unable to perform well on a Mathematics test. Other symptoms include having a "blank mind," being tense, fail to concentrate and are unable to hear the teacher (Kitchens, 1995).

Indeed, having a negative attitude towards Mathematics affects a child's self-esteem (Belbase, 2013) and impedes his or her ability to think (Das & Das, 2013). As revealed by studies, one of the common factors directly or indirectly affecting students' mathematical anxiety is the teacher's character as well as the techniques in delivering the lessons. According to Oberlin (1982), some of the teaching techniques that can cause Mathematical anxiety are: a) giving the same problems for everyone; b) solving all problems found in the textbook; c) giving daily written work; d) insisting that the problem can be solved in a single solution; and e) making Mathematics assignment as punishment for misbehavior.

As far as this study is concerned, the researchers believe that it is necessary to identify the mathematical anxiety of students in every year level. In particular, the study looks into the mathematical anxiety experienced by the top 15 performing students from Grades 1 to 10 as no study has yet been conducted in this area. It also wants to know how the students' anxiety is related to their workload (grade level topics) as well as the K to 10 curriculum in general, as this aspect has not yet been explored in the past. Lastly, the researchers would like to reveal the coherence or incoherence and the connectivity or disconnectivity of the K to 10 Mathematics curriculum of this country.

In addressing the gaps mentioned previously, the mathematical anxiety of the top 15 performing students from Grades 1 to 10 will be identified. Also, a triangulation process - which consists of interviews with Mathematics teachers, distribution of structured and open-ended questionnaires to students, and gathering of a list of topics not covered within the quarter - will be utilized. Through these, the researchers will also be able to determine precisely the factors that trigger mathematical anxiety among students.

METHODOLOGY

Data and Respondents

The study involved students from private and public schools of Dumaguete City. These schools were randomly selected, and the respondents from these schools were purposively taken to isolate the variables on teacher-factor, monthly family income, and anxiety. The respondents were the top 15 performing students from Grades 1 to 10 (n=300) and had more or less the same qualities in terms of academic achievement. Twenty teachers of the same students were also involved in this study.

The average monthly family income of the students every year is very substantial to meet their needs in school. An article published in Philippine Statistics Authority (2016) cited that a family with five members needs at least PHP 9,140 per month to supply the necessary food and other needs. Generally, the monthly family income illustrated in Figure 1 is higher than the poverty level. Thus, students in this study are considered financially stable. Meanwhile, most of the teachers were baccalaureate degree holders (65%), having Rank 1 classification (60%) and the majority (70%) have been in the teaching profession for a longer time.

In gathering the data, the triangulation process - which consisted of interviews with Mathematics teachers, distribution of structured and open-ended questionnaires to students, and gathering of a list of topics not covered within the quarter - was utilized. The researchers made use of the "Turkish Children's Anxiety in Math Scale (T-CAMS)" instrument of Kandemir, Jameson, and Palestro (2016) with permission. The 11- item questionnaire with an alpha coefficient of 0.856 was distributed to 300 students with the approval of the respective schools' division superintendents, principals, and classroom advisers. Meanwhile, the questionnaire used for the teachers covered only their educational attainment, the number of years in teaching Mathematics, and rank. Furthermore, the K to 10 Mathematics curriculum guide in 2012 was also utilized by the researchers. It has five subject areas: (1) Number and Number Sense; (2) Measurement; (3) Geometry; (4) Patterns and Algebra; and (5) Probability and Statistics, which are found in Grades 1 to 10 with increasing degrees of difficulty.

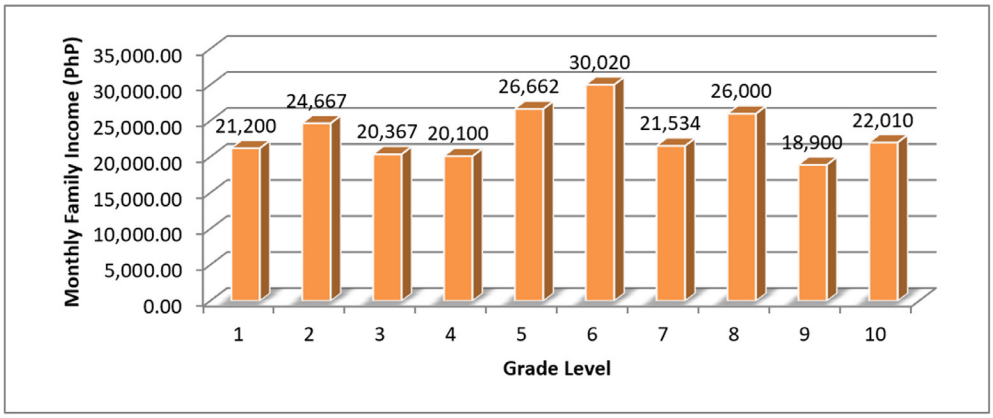

Figure 1. Students' monthly family income at each grade level

Measures

Dependent variable. The dependent variable in this study was the mathematical anxiety of the students. It was measured using the Turkish Children's Anxiety in Math Scale (T-CAMS) instrument which has 11 indicators with the following options: extremely anxious (5 points), anxious (4 points), moderately anxious (3 points), a little anxious (2 points), and not anxious (1 point).

Independent variable. The independent variables in this study were the monthly family income of the students, teacher-factor, and the number of topics in every year level. Before the conduct of the study, the students were advised to ask their parents about the monthly family income. The teacher-factor, on the other hand, consisted of the educational attainment, number of years in teaching and rank of the teachers. Their qualifications also had equivalent points (i. e. baccalaureate degree holder = 1; with MA units = 2; etc). Furthermore, the number of topics in every year level was taken from the Department of Education K to 10 Mathematics curriculum guide and was analyzed by the researchers. The number of topics per year level was compared to the level of anxiety of the students per year level.

RESULTS

Levels of Mathematical anxiety in each grade level

Table 1 displays the numerical ratings of the students' overall level of mathematical anxiety from Grades 1 to 6. It is very observable that the figures increase from lower grade levels to upper-grade levels. Comparing the weighted means obtained in every subsequent grade level, the students' level of mathematical anxiety significantly differs from Grades 5 to 6 ($p=0.012$). The data also reveal that generally, in Grade 4 the weighted mean is 1.92. This figure signifies little anxiety already. Likewise, students in Grades 5 and 6 also manifest little anxiety with weighted means of 2.10 and 2.54, respectively. Moreover, the data illustrate that the same pattern

Table 1. Students' level of Mathematical anxiety at each grade level

Grade	Percentage of Students Who Responded in a Particular Category (%)					Overall Anxiety ($w\bar{x}$)	Verbal Description	Mann-Whitney p-value
	Extremely Anxious	Anxious	Moderately Anxious	A Little Anxious	Not Anxious			
1				26.67	73.33	1.45	Not Anxious	
2			3.33	30.00	66.67	1.65	Not Anxious	
3			10.00	30.00	56.67	1.67	Not Anxious	
4		3.33	3.33	56.67	36.67	1.92	A Little Anxious	
5		10.00	6.67	40.00	43.33	2.10	A Little Anxious	
6		13.33	30.00	43.33	13.33	2.54	A Little Anxious	0.012
7		6.67	23.33	46.67	23.33	2.28	A Little Anxih ous	
8		33.33	43.33	26.67	3.33	3.05	Moderately Anxious	0.000
9	10.00	26.67	30.00	30.00	3.33	3.07	Moderately Anxious	
10	3.33	16.67	43.33	16.67	20.00	2.75	Moderately Anxious	

Note: $n = 30$ in every grade level; $\alpha = 0.05$

*The p-value of 0.012 and 0.000 signify that there is indeed a significant leap on the levels of anxiety from Grade 3 to Grade 6 and Grade 7 to Grade 8.

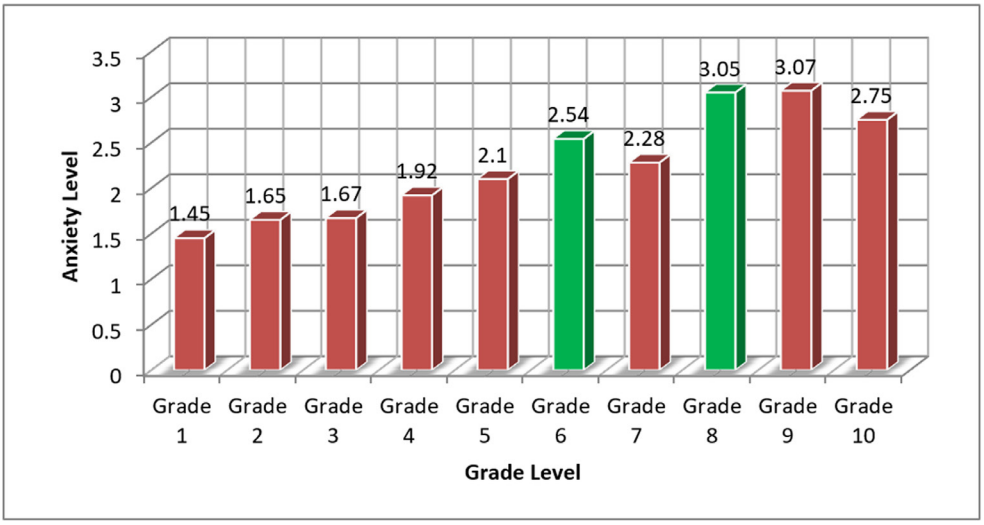

Figure 2. Anxiety levels of students across grade levels

is noted from Grades 7 to 9 and comparing the weighted means obtained in every subsequent grade level, the students' level of mathematical anxiety significantly differs from Grades 7 to 8 ($p=0.000$).

Lastly, the data revealed that Grade 9 students attain the highest weighted mean of 3.07 which indicates a moderate level of anxiety towards the subject.

The 2012 DepEd K to 10 Mathematics curriculum

The 2012 Department of Education curriculum from Grades 1 to 10 was designed under the preamble that "Mathematics is one subject that pervades life at any age, in any circumstance." The value of Mathematics goes beyond the school setting. Thus, it should be learned with much depth.

The approach is a spiral progression of topics, that is, bits and portions of the five subject areas are taken in each year level with an increasing degree of difficulty as the child progresses to higher year levels. Thus, although the subject areas do not change, new objectives and advanced sub-topics are introduced at every level.

In Grades 1, 2, and 3, the following are the topics with an increasing level of difficulty from Grades 1 to 3: Whole Numbers; Fractions; Money; Geometry; Patterns and Algebra; Measurement; and Graphs and Simple Probability.

In Grades 4 and 5, an additional sub-topic on decimals including money was adjoined to the previous set of topics. Topics on Percent and Ratio and Proportion were also added in Grade 5. These made the total number of topics for Grades 4 and 5 equal to 8 and 10.

In Grade 6, all of a sudden, three additional topics were integrated into the curriculum: Exponents, Integers, Algebraic Expressions, and Equations. These made the total number of topics in this level to 13.

In Grades 7 and 8, important sub-topics for Number Sense, Measurement, Algebra, Geometry, Probability, and Statistics were added. However, in Grade 8, the following sub-topics, among others, are placed: systems of linear inequalities, word problems on systems of linear equations, word problems on linear inequalities, axiomatic development of geometry, nature of proofs, inequalities in triangles, counting principles,

permutations, and combinations.

In Grade 9, there is no Probability and Statistics. However, Trigonometry was introduced as a new topic in addition to Algebra and Geometry; the latter two are also offered in Grade 10 along with Probability and Statistics again.

Below is the matrix of topics in both the Elementary and Junior High School.

Table 2. Grade level topics in the elementary (part 1)

Grades 1, 2, and 3	Grade 4
1. Whole Numbers	1. Whole Numbers
2. Fractions	2. Fractions
3. Money	3. Decimals Including Money
4. Geometry	4. Geometry
5. Patterns and Algebra	5. Patterns and Algebra
6. Measurement	6. Measurement
7. Graphs and Simple Probability	7. Graphs and Probability Experiment
	8. Number Theory

Table 3. Grade level topics in the elementary (part 2)

Grades 5	Grade 6
1. Whole Numbers	1. Whole Numbers
2. Fractions	2. Fractions
3. Decimals Including Money	3. Decimals
4. Geometry	4. Geometry
5. Measurement	5. Measurement
6. Patterns and Algebra	6. Patterns and Algebra (Formulating Rules for Sequences)
7. Graphs	7. Graphs
8. Factors and Multiples	8. Simple Probability
9. Percent	9. Understanding Percent
10. Ratio and Proportion	10. Ratio and Proportion
	11. Exponents
	12. The Set of Integers
	13. Patterns and Algebra (Algebraic Expressions, Equations)

Table 4. Topics in junior high school (part 1)

Grades 7	Grade 8
1. Key Concepts of Sets and Operations	1. Special Products
2. Real Numbers and Their Properties	2. Factoring
3. Operations on Integers	3. Rational Algebraic Expressions
4. Operations on Rational Numbers	4. Operations on Rational Algebraic Expressions
5. Operations on Decimals	5. Rectangular Coordinate System
6. Measurement	6. Representation of Relations and Functions
7. Constant, Variables and Algebraic Expressions	7. Linear Functions and Its Applications
8. Verbal Phrases and Mathematical Phrases	8. Forms of Linear Equations
9. Operations on Polynomials	9. Linear Inequalities in Two Variables
10. Laws of Exponents	10. Systems of Linear Equations in Two Variables
11. Special Products	11. Systems of Linear Inequalities in Two Variables
12. Linear Equations in One Variable	12. Graphical Solutions of Systems of Linear Inequalities in Two Variables
13. Linear Inequalities in One Variable	13. Word Problems on Systems of Linear Equations
14. Word Problems Involving Linear Equations in One Variable	14. Word Problems on Linear Inequalities
15. Word Problems Involving Linear Inequalities	15. Axiomatic Development of Geometry
16. Basic Concepts/ Terms in Geometry	16. If-Then Statements
17. Geometric Shapes/Constructions	17. Converse, Inverse, Contrapositive
18. Statistics and Basic Terms	18. Inductive and Deductive Reasoning

Table 4. Con't...

19. Collection, Organization, and Presentation of Data	19. Nature of Proofs
20. Measures of Central Tendency of Ungrouped Data	20. Definition of Congruent Triangles
21. Analyzing, Interpreting and Drawing Conclusions	21. Inequalities in Triangles
22. Statistical Tables and Graph	22. Parallelism and Perpendicularity
	23. Measures of Central Tendency of Ungrouped Data
	24. Measures of Variability of Ungrouped Data
	25. Measures of Tendency of Group Data
	26. Measures of Variability of Group Data
	27. Statistical Experiment, Outcomes, Sample Space and Events
	28. Experimental and Theoretical Probability
	29. Counting Principles, Permutations and Combinations

Table 5. Topics in junior high school (part 2)

Grades 9	Grade 10
1. Illustrations of Quadratic Equations	1. Arithmetic Sequence
2. Solving Quadratic Equations by Extracting Square Roots	2. Geometric and Other Sequences
3. Solving Quadratic Equations by Factoring	3. Division of Polynomials
4. Solving Quadratic Equations by Completing the Square	4. Remainder Theorem and Factor Theorem
5. Solving Quadratic Equations by Using Quadratic Formula	5. Polynomial Equations
6. The Nature of the Roots of a Quadratic Equations	6. Polynomial Functions
7. Equations Transformable to Quadratic Equations	7. Chords, Arcs and Central Angles
8. Solving Problems Involving Quadratic Equations	8. Arcs and Inscribed Angles
9. Quadratic Inequalities	9. Tangents and Secants of a Circle
10. Introduction to Quadratic Functions	10. Tangent and Secant Segments
11. Graphs of Quadratic Functions	11. Distance Formula and Midpoint Formula
12. Finding the Equation of a Quadratic Function	12. The Equation of a Circle
13. Applications of Quadratic Functions	13. Permutations
14. Direct, Inverse, Joint, Combined Variations	14. Combinations
15. Zero, Negative and Rational Exponents	15. Union and Intersection of Events
16. Radicals	16. Independent and Dependent Events
17. Solving Radical Equations	17. Conditional Probability
18. Quadrilaterals	18. Measures of Position for Ungrouped Data
19. Similarity	19. Measures of Position for Grouped Data
20. The 6 Trigonometric Ratios	
21. Trigonometric Ratios of Special Angles	
22. Angles of Elevation and Angles of Depression	
23. Word Problems Involving Right Triangle	
24. Oblique Triangles	
25. The Law of Sines and Its Applications	
26. The Law of Cosines and Its Applications	

The number of topics across grade levels can be shown in the bar graph below:

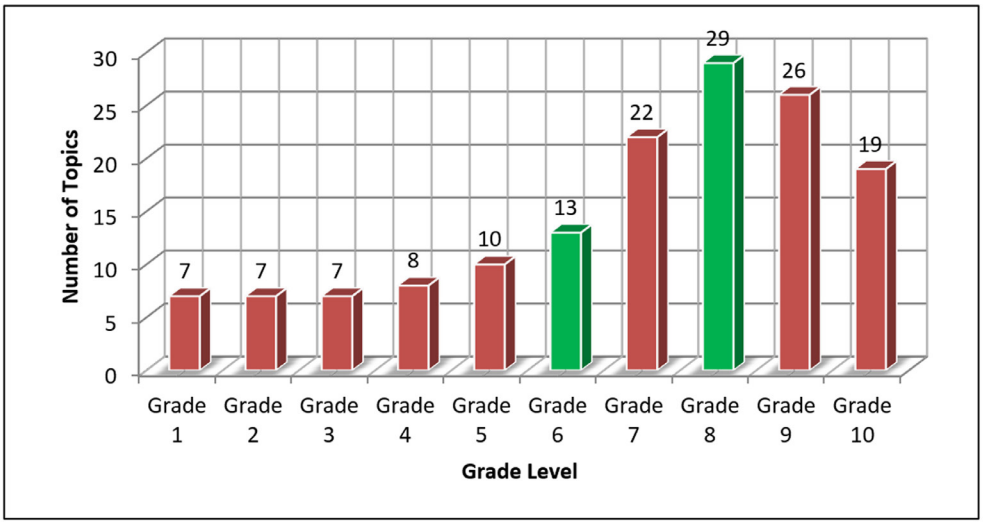

Figure 3. Number of topics per grade level

Relationship between students' Mathematical anxiety and selected variables (teacher-factor and monthly family income)

As presented in Table 6, there is no correlation between the selected variables (teacher-factor and monthly family income) and level of students' mathematical anxiety in the Grade 6 level, but there is a significant surge of the level of students' mathematical anxiety from Grades 5 to 6. Hence, this surge could only be attributed to the introduction of 3 new topics in Grade 6 (refer to Table 3) which was not previously pre-spiraled in the earlier grade levels. These new topics are the following: exponents, integers, and patterns and algebra (algebraic expressions and equations).

This is also true in the students' transition from Grades 7 to 8. From Table 6, it can be observed that there is a significant surge of anxiety level from Grades 7 to 8 in which there is no significant relationship between the selected variables (teacher-factor and monthly family income) and students' anxiety level. Thus, this significant rise in anxiety level can only be attributed to the curricular offerings in the Grade 8 level. Worth noting is that during the Grade 8 level, all the tough topics in the five content areas are visible. These are, among others, systems of linear inequalities, word problems on systems of linear equations, word problems on linear inequalities, axiomatic development of geometry, nature of proofs, inequalities in triangles, counting principles, permutations, and combinations.

DISCUSSION

The study mainly focused on identifying the level of mathematical anxiety of the top performing students in every year level and how their anxiety is related to their workload as well as the K to 10 curriculum in general. With this, the researchers would be able to reveal the coherence or incoherence and the connectivity or disconnectivity of the K to 10 Mathematics curriculum of this country.

The study indicated that as the level of abstraction of mathematical concepts gets higher, so does the students' mathematical anxiety.

Table 1. Students' level of Mathematical anxiety at each grade level

Grade	Level of Anxiety	Percent of Increase/ Decrease		Teacher- Factor	Monthly Family Income
1	1.45			Significant	Not Significant
2	1.65	13.79%	Not Significant	Not Significant	Not Significant
3	1.67	1.21%	Not Significant	Significant	Not Significant
4	1.92	14.97%	Not Significant	Not Significant	Not Significant
5	2.10	9.38%	Not Significant	Not Significant	Not Significant
6	2.54	20.95%	Significant*	Not Significant	Not Significant
7	2.28	-10.24%	Not Significant	Significant	Not Significant
8	3.05	33.77%	Significant*	Not Significant	Not Significant
9	3.07	0.66%	Not Significant	Not Significant	Not Significant
10	2.75	-10.42%	Not Significant	Not Significant	Not Significant

*p-value < 0.05 using t-test/Whitney-Mann U test
** use of Spearman-rho on the relationship between anxiety and teacher-factor/monthly family income

The students' anxiety is at its peak in Grade 6 for the elementary level where more topics are found, and highest in Grade 9 for the high school level. Similarly, more topics are found in Grades 8 and 9 at the high school level. The study further revealed that there is no correlation between the selected variables (teacher-factor and monthly family income) and level of students' mathematical anxiety in the Grade 6 level, but there is a significant surge of the level of students' mathematical anxiety from Grades 5 to 6. This is also true in the students' transition from Grades 7 to 8. The significant rise in anxiety level from Grades 7 to 8 has no significant relationship between the selected variables (teacher-factor and monthly family income) and students' anxiety level.

The study of Quilnet (2015) is in line with the findings of the current study on an overloaded curriculum. She revealed that Grade 8 teachers encountered a severe problem of allocating time for Patterns, Algebra, Geometry, Statistics, and Probability. This result was corroborated by the findings of the Division of Siquijor in its report on the Consolidated Lists of Competencies Not Covered in the Quarter. The problems on the overloaded contents of high school curriculum specifically in Grade 8 were likewise pointed out by teachers in an interview conducted by the researchers. In open-ended questions given to students in Grade 8 level, the numerous difficult topics were also stressed by them.

On the other hand, the study of Caplan and Jones (1975) revealed that subjective workload and anxiety were directly related. Further, the study of Greenglass, Burke, and Moore (2003) on the effect of workload to 488 nurses working in hospitals indicated that the data fit on the model that workload had a considerable contribution to levels of depression. Workload also affects students' performance in school. Chambers (1992) found out that reasonable student workload is a requisite of effective studying and learning.

In large measure, grade level as a factor is attributed to the curricular offerings in the respective grade levels. Taking the above findings from the point of view on teaching and learning,

teachers in some grade levels, particularly in Grade 6 and Grade 8, are loaded heavily with many subject areas and un-spiraled topics from the previous year levels. This scenario indeed leads to anxiety on the part of the teachers and students in these grade levels.

On the other hand, the study also had the following limitations: it did not include kindergarten pupils since they still needed assistance in answering the questionnaires and biases might occur; the senior high school students also were using the new K-12 curriculum and it is premature to judge the effectiveness of the curriculum; the groups of top performing students from Grades 1 to 10 were assumed to have more or less the same academic ability; lastly, the non-performing students were not considered in this study for they might have other factors contributory to their mathematical anxiety aside from those factors involved in this study. It is therefore suggested that a longitudinal study will be conducted such that the same groups of students will be evaluated from Grades 1 to 10 or even from Kindergarten to Grade 10.

CONCLUSION

Students' mathematical anxiety heightens when the students are confronted with subject matters that are new and come in bulk. This phenomenon happened when new subject matters were introduced in Grade 6 and were not adequately addressed in Grade 5. The case of anxiety surge in Grade 8 is a case of a concentration of too many difficult topics that were not adequately pre-spiraled in the previous year levels.

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