A CROSS-ETHNIC COMPARISON OF MATHEMATICS ACHIEVEMENT IN THE TRENDS IN INTERNATIONAL MATHEMATICS AND SCIENCE STUDY 2011 (TIMSS)

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Abstract:

The educational system in Macedonia is comprised of preschool, primary, secondary, and higher education. The official language in the Republic of Macedonia is Macedonian; all national groups in Macedonia are entitled to primary and secondary education in their native language. In primary schools, instruction is provided in Macedonian, Albanian, Turkish, and Serbian language. Turkish and Serbian ethnic groups make up less than 5 percent of the population and that is why TIMSS 2011 was conducted only in Macedonian and Albanian language.

Low achievement level (below the international average) of Macedonian students in mathematics is a well-known and determined fact for many years. Results of the TIMSS 2011 have revealed many open questions about the differences in performance between ethnic Macedonian and ethnic Albanian students. Ethnic Albanian students have far lower performance in TIMSS studies compared to Macedonian.

The main objective of this study is to explore the achievement motivation of the students as a factor behind the differences.

The study combines students' answers on TIMSS 2011 scales about three motivational constructs: intrinsic value, utility value and ability beliefs with their mathematics achievement scores obtained from TIMSS 2011 Mathematics Achievement Test. The

expectancy-value theory of achievement motivation is been used as a theoretical framework (Wigfield & Eccles, 2002).

The data is obtained from 2600 students ethnic Macedonians and 1600 students ethnic Albanians tested within 150 schools from Macedonia.

Results from the multivariate regression models reveal that student's ability beliefs are strong predictors of mathematics achievement both for Macedonian and Albanian eighth-graders. Utility value is a significant predictor for the Macedonian students; intrinsic value for the Albanian students.

Keywords:

achievement motivation, ability beliefs, intrinsic value, utility value, multivariate regression models

Purpose:

The study aims to provide the predictors of achievement in mathematics for ethnic Macedonians and ethnic Albanians.

Educational or academic significance of research:

The findings from the study can help to overview and rethink the educational practices in mathematics in Macedonian schools. They will be used to revise and organize the national mathematics curriculum as well as the content and methodology of the seminars for teachers about special teaching methods to engage students in learning mathematics and develop their intrinsic motivation.

Teachers can think about the motivation through the expectancy-value model of motivation (Wigfield, Tonk, & Eccles, 2004). In this model, motivation is sometimes written with a multiplicative formula: expectancy x value = motivation. The relationship between expectation and value is "multiplicative" rather than additive because in order to be motivated, it is necessary for a student to have at least a modest expectation of success

and to assign a task at least some positive value. If a student has high expectations of success but does not value a task at all (mentally assign it a "0" value), then he/she will not feel motivated at all. Likewise, if he/she values a task highly but has no expectation of success about completing it (assign it a "0" expectancy), then he/she will also not feel motivated at all.

Expectancies are result of various factors, but particularly the goals held by a student, and the student's self-efficacy. A student with mastery goals and strong self-efficacy for a task, for example, is likely to hold high expectations for success—almost by definition. Values are also result of various factors, but especially students' interests and feelings of self-determination. A student who has a lasting personal interest in a task or topic and is allowed to choose it freely is especially likely to value the task—and therefore to feel motivated.

Ideally both expectancies and values are high in students on any key learning task. The reality, however, is that students sometimes do not expect success, nor do they necessarily value it when success is possible. How can a teacher respond to low expectations and low valuing? Raising low expectations depends adjusting task difficulty so that success becomes a reasonable prospect: a teacher must make tasks neither too hard nor too easy. Reaching this general goal depends on turn on thoughtful, appropriate planning—selecting reasonable objectives, adjusting them on the basis of experience, finding supportive materials, and providing students with help when needed.

Raising the value of academic tasks is equally important, but the general strategies for doing so are different than those for raising expectations. Increasing value requires linking the task to students' personal interests and prior knowledge, showing the utility of the task to students' future goals, and showing that the task is valuable to other people whom students' respect.

Perspectives or theoretical framework:

Each successive TIMSS assessment has shown a strong positive relationship within countries between student attitudes toward mathematics and their mathematics achievement. There is extensive research showing that students with more positive

attitudes toward mathematics have higher average achievement in mathematics (Mulis, Martin, Foy and Arora, 2012).

A number of researches about students' attitudes toward learning have studied the complex phenomenon of motivation. For example, students' motivation to learn can be affected by whether they find the subject enjoyable and place value on the subject. In addition, students' motivation can be affected by their self-confidence in learning the subject. Intrinsic motivation of students refers to doing an activity because it is interesting or enjoyable. In contrast, extrinsic motivation refers to doing something because it leads to a desirable outcome. A strong self-concept encourages students to engage with the instruction and show persistence, effort, and attentiveness.

Motivation has been defined as "the process whereby goal-directed activity is instigated and sustained" (Pintrich & Schunk, 2002, p.5). A similar definition is presented by Phye (1997), who defines motivation as an internal state that arouses, directs, and maintains behavior. It is not possible to observe this internal state process, the theory is necessary in measurement of motivational beliefs. Due to the latency of psychological constructs, the construct motivation can be conceptualized in different ways, with different theories focusing on different psychological processes. The modern achievement motivation paradigm is dominated by cognitive theories, which claim that individuals' thoughts, beliefs, and emotions together influence motivation. The most modern theories on motivation also incorporate a sociocultural perspective, where it is acknowledged that the surrounding social context interacts with the individual and influences his or her motivational beliefs. The general theoretical framework of this study is the social cognitive expectancy-value model of achievement motivation. The most widely used expectancy-value model currently comes from the work of Eccles and Wigfield and their colleagues (Eccles & Wigfield, 2002). It is difficult to apply the entire model in a single study, but it allows the researcher to focus on a smaller part of the model while still not losing sight of the big picture.

The expectancy-value theory is highly relevant in relation to the content of the motivational items included in the TIMSS student background questionnaire. This theory model of achievement motivation has two core components; one **expectancy component**

corresponds to the question "Can I do this task?" and one **value component** that corresponds to the question "Do I want to do this task and why?".

The expectancy component in the model thus refers to the individual's beliefs and judgments about his or her capabilities to do a task and succeed at it (ability beliefs). In TIMSS 2011 it is represented by the Students Confident in Mathematics scale.

The value component in the model refers to the various reasons that individuals have when engaging in a task or not. The different value components are attainment value (or importance), intrinsic value (or interest), utility value (or usefulness) and cost. In TIMSS 2011 intrinsic value is measured by the Students Like Learning Mathematics scale; and utility value with the Students Value Mathematics scale.

In this study students' ability beliefs and valuing mathematics are perceived as aspects related to student motivation.

Methods, statistical techniques, and/or modes of inquiry:

Multivariate regression analysis was deployed to reveal the impact of the student's background variables on mathematic achievement (TIMSS 2011). The variables are tested within three scales about three motivational aspects:

1. Students Like Learning Mathematics scale. Students were scored according to the degree of their agreement with five statements: "I enjoy learning mathematics", "I wish I did not have to study Mathematics" (reverse coded), "Mathematics is boring" (reverse coding), "I learn many interesting things in Mathematics", "I Like mathematics". Students in the Like learning Mathematics category "agreed a lot" with three of the five statements and "agreed a little" with the other two, on average. In contrast, students who Do not Like Learning Mathematics "disagreed a little" with three of the statements and "agreed a little" with the other two, on average.

2. Students Value Mathematics scale. The scale addresses six different aspects of valuing Mathematics: "I think learning Mathematics will help me in my daily life", "I need Mathematics to learn other school subjects, "I need to do well in mathematics to get into the university of my choice", "I need to do well in Mathematics to get the job

I want", "I would like a job that involves using mathematics", "It is important to do well in mathematics". Students with a score corresponding to "agreeing a lot" with three of the statements and "agreeing a little" with the other three, on average were considered to Value mathematics. In comparison, students in the Do not Value mathematics category "disagreed a little" with three of the statements and "agreed a little" with the other three, on average.

3. Students Confident in mathematics scale. The scale includes seven statements: "I usually do well in mathematics", "Mathematics is more difficult for me than for many of my classmates (reverse coded), "Mathematics is not one of my strengths (reverse coded), "I learn things quickly in mathematics", "Mathematics makes me confused and nervous" (reverse coded), "I am good at working out difficult mathematics problems", My teacher thinks I can do well in Mathematics with difficult materials", "My teacher tells me I am good at mathematics", "Mathematics is harder for me than any other subject" (reverse coded). Confident students "agreed a lot" with four of the seven statements and "agreed a little" to the other three on average. Students Not Confident in Mathematics "disagreed a little" with four of the statements and "agreed a little" with the other three, on average.

IEA IDB Analyzer was used for the Student-level regression analyses.

Data sources: This study utilizes data from TIMSS 2011 Macedonian student database.

Results and discussion:

Correlation analysis between phenomena indicates the degree and direction of association between variables.

In the Table 1 are given the definition variable that are included in the model.

[Insert Table 1]

Dependent variable is Student matematic achivment. Independet variables are: Students Like Learning Mathematics (REGBSDGSLM), Students Value Mathematics (REGBSDGSVM) and Students Confident in Mathematics (REGBSDGSCM).

Findings from the multivariate regression analyses are presented in Table 2.

[Insert Table 2]

For both ethnic groups the results are displayed on four lines: the first for the intercept (CONSTANT), and the second for the REGBSDGSCM, REGBSDGSLM and REGBSDGSVM coefficients.

The first line of results in Table 1, labeled "(CONSTANT)," is the estimated average mathematics achievement of eighth grade Macedonian students, which is 444.54 with a standard error of 6.98.

Ethnic Macedonian students that are not confident in mathematics have average achievement difference of 109.95. With an estimated standard error of 6.26, this achievement difference is statistically significant at the 99% confidence level.

Ethnic Macedonian students that do not like learning mathematics have average achievement difference of 2.41. With an estimated standard error of 5.48, this achievement difference is not statistically significant.

Ethnic Macedonian students who do not value mathematics have average achievement difference of -16.69. With an estimated standard error of 5.90, this achievement difference is statistically significant at the 95% confidence level.

The fifth line of results in Table 1, labeled "(CONSTANT)," is the estimated average mathematics achievement of eighth grade ethnic Albanian students, which is 368.91 with a standard error of 8.53.

Ethnic Albanian students who are not confident in mathematics have average achievement difference of 28.92. With an estimated standard error of 10.63, this achievement difference is statistically significant at the 95% confidence level.

Ethnic Albanian students who do not like learning mathematics have average achievement difference of 30.99. With an estimated standard error of 8.75, this achievement difference is statistically significant at the 99% confidence level.

Ethnic Albanian students who do not value mathematics have average achievement difference of 3.04. With an estimated standard error of 6.80, this achievement difference is not statistically significant.

From the results it is evident that Ethnic Albanian students have far lower achievement compared to ethnic Macedonian students.

For the ethnic Albanian students ability beliefs and intrinsic value are strong predictors of mathematics achievement. Ethnic Albanian students do not value mathematics as an important factor to get the job they want, maybe because they think that the working places that involve using mathematics are reserved for the Macedonian students.

For ethnic Macedonian students ability beliefs and utility value are strong predictors of mathematics achievement. Macedonian students are aware that mathematics knowledge is very important to get the job they want, but they don't like to learn math. The reason can be found in context of external testing in the country. Teachers are much stressed about the results of the external testing and they strive to cope with the stress by giving students tasks that are beyond their knowledge and ability, and in that way they have negative influence on students liking to learn mathematics.

Conclusions and/or point of view:

Teachers and students are on a pressure to get better results on an external testing by the end of the school year. Tests will grade how much the teachers taught the student at the end of the year and the tests are on the entire material. It should be stressed that there is growing evidence that mandated testing has a number of unintended negative effects on teachers and students. At the most basic level, high-stakes testing puts extraordinary pressure on teachers to teach for the test and to insure student success on such tests. The power of situations in this regard, as social psychology has repeatedly demonstrated to be considerable. Furthermore, mandated testing often leads to the use of particular classroom instructional methods such as practice on test-like items that are often at odds with teachers owing preferred instructional strategies and assessment practices and may lead to diminished motivation for teachers to this work in the short term and the long term. Such a dampening of teacher enthusiasm could in turn adversely affect student's own motivation, effort and achievement.

To the external testing context in Macedonia, we can add the regular teacher trainings on Bloom's Taxonomy of cognitive domains as well as trainings on how to develop testing

questions with a multiple choice. The affective domain, the manner in which students deal with things emotionally, such as feelings, values, appreciation, enthusiasms, motivations, and attitudes are left behind.

Identified predictors suggest the changes that are necessary to be done to achieve better results in mathematics both for ethnic Macedonian and ethnic Albanian students. Changes are needed in math curricula development, teacher's pre service and in service training for development of more effective instructional practices to nurture the inner motivational resources of the students. Accurate measurement of the indexes of motivation in dynamic learning environments is important because without such assessment, appropriate modification of motivational supports cannot occur.

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Table 1

Variable	Description
Grouping Variaples	
Language of testing ITLANG	1 = Macedonian 2 = Albanian
Dependent Variable – Plausible Values	
Mathematic achievement	mathematic achievement
Independent Variable	
Students Like Learning Mathematics REGBSDGSLM	1 = confident 0 = somewhat confident 0 = not confident
Students Value Mathematics scale REGBSDGSVM	1 = confident 0 = somewhat confident 0 = not confident
Students Confident in Mathematics REGBSDGSCM	1 = confident 0 = somewhat confident 0 = not confident

Table 2

Regression Coefficients

LANG	Variable	Regression Coefficient	Regression Coefficient (s.e.)	Regression Coefficient (t-value)	Stndrdzd. Coefficient	Stndrdzd. Coefficient (s.e.)	Stndrdzd. Coefficient (t-value)
Macedonian	(CONSTANT)	444.54	6.98	63.66	.	.	.
	REGBSDGSCM	109.95	6.26	17.55	.42	.02	19.57
	REGBSDGSLM	2.41	5.48	.44	.01	.02	.44
	REGBSDGSVM	-16.69	5.90	-2.83	-.08	.03	-2.84
Albanian	(CONSTANT)	368.91	8.53	43.23	.	.	.
	REGBSDGSCM	28.92	10.63	2.72	.07	.03	2.66
	REGBSDGSLM	30.99	8.75	3.54	.15	.04	3.55
	REGBSDGSVM	3.04	6.80	.45	.02	.04	.44