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## Differences in the use of learning strategies in mathematics in 8<sup>th</sup> and 9<sup>th</sup> grade

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### Abstract

Learning strategies are indispensable tools for autonomous and self-regulated learning. The objective of this research is to identify differences in the use of learning strategies in the area of mathematics in 8th and 9th grade, that is, in the transition from Middle School to Junior High School. The research has been conducted in different schools located in the Basque Country (Spain) and collects data from 403 students (8th and 9th graders) using the Motivated Strategies for Learning Questionnaire (MSLQ), adapted to the study of mathematics. The findings show statistically significant differences in favour of 9th grade students in the employment of organization, metacognition and help seeking strategies. The effect-size is between weak and moderate.,

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### 1. Introduction

The concepts of self-regulation and learning strategies often tend to be used interchangeably (Dinsmore, Alexander, and Loughlin, 2008). The self-regulated learning theory forms a theoretical framework that has allowed the momentum of research on academic learning strategies. The self-regulation acquires the status of relevant educational goal that arouses interest in understanding the processes, conditions and factors of self-regulated learning.

Pintrich is an important author on the study of strategies largely due to its proposal Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich, Smith, Garcia, and McKeachie, 1991), which has been widely used in previous research in secondary school, high school and university students.

This questionnaire is divided into two blocks, on learning strategies and information processing and on motivation. The block which covers strategies include three categories: cognitive, metacognitive and contextual. Cognitive strategies are four: rehearsal (measures strategies to learn by repetition), organization (taking into account the ways of managing mathematical learning), elaboration (measures how incoming information is related to existing materials in the record of the subject), and critical thinking. The second category is metacognitive Strategies and consists of planning (gathering information on how studies are planned), monitoring (assessing the awareness, knowledge and control they have over their own student cognition), and regulation (refers to the ability to control the effort and attention versus distractions or to difficult tasks). The third category is resource management strategies. These include time management and study environment, peer learning and help seeking.

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**2. Objectives**

Given the importance of learning strategies to achieve meaningful learning, this study aims to identify differences in the use of learning strategies among students completing Middle School and Junior High School beginning. It is important to study the evolution between the two stages and phases that are educational outlining future instructional skills.

**3. Method**

The research has been collecting data by students enrolled in 8th 403 (14-16 years old) and 9th grade (15-17 year old). In the Spanish education system these grades are for 2nd and 3rd grade of ESO.

The method to measure the use of learning strategies was the questionnaire developed by Berger, and Karabenick (2011) which is a version of the MSLQ (Pintrich et al., 1991) adapted to the learning of mathematics and translated into Spanish by the authors of this study. The scale used to measure the results has been a 5-point Likert scale (where 1 = strongly disagree and 5 = strongly agree). Sex, educational level and age were gathered by means of an anonymous survey.

All the data were collected during the 2010-2011 and the 2011-2012 academic years in different public and concerted private schools located in The Basque Country (Spain).

To process data, and given that the sample did not match the requirements to use a parametric analysis, nonparametric Mann Whitney U-test was the chosen statistic procedure for the comparison of averages. The level of significance used in the investigation was  $p < 0.05$ . The effect size, denoted by  $r$ , indicates the significance of the difference between the scores, it is considered that the effect is weak if  $r = .10$ , moderate if  $r = .30$  and strong if  $r = .50$  (Cohen, 1988).

The statistical work was done by using the PASW 18 software.

**4. Results**

The exploratory factor analysis of this study matches the version proposed by Berger, and Karabenick (2011); therefore, six factors are analyzed: rehearsal, organization, elaboration, metacognitive strategies help seeking and time and study environment management.

Cronbach alpha coefficients are sufficient in all scales ( $\alpha > .70$ ), except in time and study environment management ( $\alpha = .60$ ).

Table 1 shows the distribution of the sample by grades:

Table 1. Sample distribution by grades

Grade	N	%
8 <sup>th</sup>	192	47.6
9 <sup>th</sup>	211	52.4
N=403		

Table 2 shows the differences by grades using learning strategies:

Table 2. Differences between grades in the use of learning strategies

Strategy	Grade	Mean	Standard Deviat	P	r
Rehearsal	8 <sup>th</sup>	3.03	.91	.460	-

	9 <sup>th</sup>	2.97	.93		
Organization	8 <sup>th</sup>	2.09	1.09	.000	.19
	9 <sup>th</sup>	2.37	.92		
Elaboration	8 <sup>th</sup>	2.38	1.05	.051	-
	9 <sup>th</sup>	2.49	.86		
Metacognition	8 <sup>th</sup>	2.55	1.06	.000	.21
	9 <sup>th</sup>	2.99	.78		
Help seeking	8 <sup>th</sup>	3.23	.80	.000	.20
	9 <sup>th</sup>	3.51	.77		
Time & Study	8 <sup>th</sup>	2.65	1.01	.020	.12
	9 <sup>th</sup>	2.85	.87		

Statistically significant differences were found in organization strategy ( $Z = -3.86$ ,  $p < 0.05$ , Mann Whitney U-test), metacognition ( $Z = -4.29$ ,  $p < 0.05$ , U-test), help seeking ( $Z = -3.99$ ,  $p > 0.05$ , U-test) and time & study environment management ( $Z = -2.32$ ,  $p < .05$ ). In all of them 9th grade students get higher scores. Effect sizes are weak to moderate ( $.10 < r < .30$ ).

No statistically significant differences were found either in rehearsal or elaboration.

## 5. Discussion

The objective of this research was to analyze the variations that occur in the use of learning strategies in mathematics among students in 8th and 9th grade, i.e., the transition from Middle School to Junior High School.

The results indicate that students tested in 9th grade obtained higher scores on organization strategies, metacognition, seeking help and time management and study environment for students of 8th grade, although the effect size is weak to moderate. This means that in 9th grade math skills better organize information by transforming schemas, tables, diagrams or pictures. In addition, they exercise greater monitoring of their own learning and achieve a more dynamic and complex consciousness of their mental processes due to the difference in metacognition (Flavell, 1979). Finally, the data show that students in 9th grade more often used to call for help in case of difficulty and control over time and studio space.

In contrast, no differences were found in cognitive strategies of rehearsal and elaboration. According to these results, the students of 8th and 9th grade used with similar frequency strategies for memorizing mathematical notions and to relate the new material with those already known.

It is particularly noteworthy the absence of variation in rehearsal strategy. It can be inferred that students who have a lower level of self-regulation (8<sup>th</sup> grade) repeat or memorize in their mathematical learning to the same measure that students doing more competent use of learning strategies. The data are understandable if it is considered this strategy as a surface-processing strategy (Berger, and Karabenick, 2011).

The cognitive scale of organization represents a surface processing strategy for Schiefele (1991), while for Linnenbrick, and Pintrich (2003) is a deep-processing strategy.

Previous research on developments in those grades on the use of learning strategies is scarce. Zimmerman, and Martinez-Pons (1990) conducted a study on learning strategies in students in 5th, 8th and 11th grade. The results show an increase metacognitive strategies are 5th to 8th grade and subsequent stagnation of 8th to 11th grade. Employing organization strategy shows the same trend of 5th to 8th grade but shows a decrease from 8th to 11th grade.

A study by Liu (2009) in Middle School discusses cognitive strategies, metacognitive and behavioral in the field of mathematics, among others. It is emphasized that there are no statistically significant differences in the strategy use among grades.

To summarize, the results obtained in this research report on the increased use of certain learning strategies in passing Junior Middle School to High School. The case of the increase in metacognitive strategies is especially relevant given the importance that these strategies have on learning. Employing these strategies facilitates independent learning and self-regulation in the area of maths. This research can help design educational interventions that promote mathematical learning more effective in Compulsory Secondary School.

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