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HOW STUDENTS CAN GET BETTER GRADES – COGNITIVE SKILLS INFLUENCING ACADEMIC PERFORMANCE

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Abstract

Knowing the skills/factors that affect academic performance, we could intervene and students could realise the components influencing higher academic success. Intelligence is the capacity to solve problems by thinking, being posited as a general ability that accounts for the co-variation of many specific abilities. Both nonverbal and verbal intelligence are determined by a combination of innate capacities and acquired skills/knowledge. Attention appears to be a ubiquitous feature in perceptual experience, being plausibly a feature of cognition as well. Visual memory encompasses memory representations that maintain data about the perceptual properties of viewed stimuli, while auditory memory involves the retention of auditory information to allow time for comprehension to occur. The purpose of our research is to explore and identify cognitive skills that significantly influence academic performance (the grades/marks obtained by the students). The participants were 2nd year students at the Faculty of Physical Education and Sports within the National University of Physical Education and Sports of Bucharest, aged between 19 and 22 years. The instruments used to explore the cognitive abilities of the students were: the Prague Distributive Attention Test, the Visual Short-Term Memory Test, the Rey Auditory Test and Abstract Reasoning Test. To verify the degree of association between variables, the Sommer's d-indicator was used. The results underline significant positive associations between the results for short-term auditory memory, nonverbal intelligence and the academic performance of the students.

Keywords: Academic performance, attention, visual memory, auditory memory, nonverbal intelligence.

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1. Introduction

Over time, researchers have tried to highlight the skills/factors that affect academic performance. Knowing these, we could intervene and students could realize the components influencing higher academic results. Starting from this idea, our study investigates mental abilities that may condition higher academic success.

Intelligence is the capacity to solve problems by thinking, being posited as a general ability that accounts for the covariation of many specific abilities (Sternberg & Kaufman, 2011). Horn and Cattel (1966) discuss about fluid and crystallized intelligence. Fluid intelligence describes capacities that are innate and not dependent of on experience or prior education. Crystallized intelligence describes abilities that rely on skills, knowledge acquired from experience. Traditionally, the tests considered to measure fluid intelligence are nonverbal, while tests traditionally considered to measure crystallized intelligence are verbal. But it seems that "fluid" and "crystallized" are not very good labels for the two commonly types of tests (verbal and nonverbal). Johnson and Bouchard (2007) and Johnson et al. (2007) assert that nonverbal intelligence cannot be entirely fluid (independent of experience), because it may be improved by training and because it is influenced by environmental factors in studies of heritability. Also, verbal intelligence cannot be entirely dependent on experience (crystallized), because it is genetically influenced - it is just as heritable as nonverbal intelligence. Thus, both nonverbal and verbal intelligence are determined by a combination of innate capacities and acquired skills/knowledge. As Kaufman (2013) mentioned, "it is incorrect to assume that tests of nonverbal fluid reasoning are somehow measuring intelligence in its purest form, completely divorced from experience and culture" (p. 192). Likewise, a vocabulary test or a general knowledge test often requires inference and deduction, involving fluid reasoning skills - influenced both by genes and culture (which are always interacting with each other). However, as the author argues, fluid reasoning involves inferring underlying patterns based on minimal data, whereas tasks encompassing a well-organized knowledge base place fewer demands on fluid reasoning.

Attention appears to be a ubiquitous feature in perceptual experience, being plausibly a feature of cognition as well (Wu, 2011). Through attention, a person performs an important selection of the stimuli. A student in class, for example, can select specific items among many items, objects, features or the contents of various possible thoughts. Attention is necessary to get things done, accompanying mental activity, appearing as a background condition, helping us to serve action - both bodily and mental behaviours (reasoning, imagining, thinking etc.). Horghidan, Mitrache and Tüdös (2001) argue that, through attention, mental energy can be focused on an internal/external event (sensory event or psychological event). Attention can be divided into three kinds: selective, distributive and sustained attention (Sun, Hu, & Liu, 2014). Distributive attention involves two or more arousals in the individual. In these conditions, for completing complex tasks, attention will be assigned to different activities. In class, students may have difficulties in maintaining and switching attention, in performing efficient complex tasks involving multiple simultaneous decisions. In the field of sport, it has been found that attention represents a good predictor for the decision time (Grigore, Predoiu, & Păunescu, 2015). In order to obtain better results (as a student) when evaluating attention and, as a consequence, maybe better results at school, practicing team sports is very important (Grigore, Mitrache, Predoiu, & Păunescu,

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2013). Also, we mention Tüdös, Predoiu and Predoiu (2015) and Grigore, Predoiu, Predoiu and Mitrache (2016) who emphasize that, for better performance in sports competitions (and in academic competition, which is not too different in terms of mental abilities, involving intelligence, willpower, logical thinking, creativity, perseverance, self-confidence etc.), it becomes essential, in the preparation process, to perform tasks demanding attention.

Visual memory encompasses memory representations that maintain data about the perceptual properties of viewed stimuli, but the format in which the information is encoded can vary from low-level imagistic representations to higher-level visual representations (Luck, & Hollingworth, 2008). Visual memory can be subdivided into visual sensory memory, visual short-term memory (VSTM) and visual long-term memory (VLTM). Authors mention that visual short-term memory and visual working memory are typically used to refer to the same memory system and VSTM is highly robust over changes position (Phillips, 1974). VSTM maintains visual information from objects, schemes for many seconds, and the consolidation of data (into VSTM) is dependent on attention. It seems that VSTM representations provide the starting point for building VLTM representations. Regarding auditory memory, it involves the retention of auditory information to allow time for comprehension to occur. This retention of auditory data is referred to as "short-term auditory memory" (Mense, Debney, & Druce, 2006). Authors have found that children with short-term auditory memory difficulties may: seem distracted, appear to daydream, say "What?" a lot, be unresponsive to verbal instruction or became frustrated. Rowe and Rowe (2007) assert that difficulties (in the case of children) in the area of learning, attention, social skills or behaviour (after assessments made by psychologists, paediatricians, audiologists) are caused by the difficulties experienced with auditory processing or short-term auditory memory.

2. Problem Statement

There is no doubt that identifying the mental factors that affect academic performance is a relevant research theme. Shoukat et al. (2013) have found that student's marks (as a dependent variable) depend on the father's/ guardian's social economic status, student's age and daily study hours. Along with these three factors highlighted, researchers also investigated the gender, residential area, accommodation trend, tuition, faculty of study and schooling environment (as independent variables). But only the income, age and study time significantly correlated with student's performance. Thus, the income level of parents has a positive effect upon the test score recorded by the students, in the case of Islamia University. Other researchers (Considine & Zappala, 2002) achieved similar results in Australia - parents' social status positively influences student's academic performance. Regarding age, the results underlined a negative correlation, while the strongest connection observed was between the academic success and study hours (study time) - considered as the most important factor influencing the student's academic performance. Other studies rely on the facilities offered by the school. It was argued (Crosnoe, Johnson, & Elder, 2004) that the existing resources/facilities in school play an important role, positively influencing the academic performance of the students. But which are the mental factors that condition academic performance? We know, based on common sense, that the following are important to obtain good grades: intelligence, memory, attention, conscientiousness, emotional control, perseverance, mental strength, motivation, willpower, observation, logical thinking, creativity, self-confidence etc. But, again, are some mental

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abilities significantly associated with high academic success? The present research investigates this aspect, more exactly, studies the importance of nonverbal (fluid) intelligence, the importance of visual and auditory memory and of distributive attention.

3. Research Questions

Given the complexity of the domain, including diverse influences of socio-demographic variables, the present study asks if there are any significant associations between the results for distributive attention, nonverbal intelligence, visual short-term memory, short-term auditory memory and the academic performance of the students. Thus, the hypothesis we want to test is H1: There are significant associations between the performances obtained by the students for cognitive skills (nonverbal intelligence, visual short-term memory, short-term auditory memory, distributive attention) and the academic performance (the overall average of grades/marks).

4. Purpose of the Study

The purpose of our research is to explore and identify cognitive skills that significantly influence academic performance (the grades/marks obtained by the students).

5. Research Methods

5.1. Participants

The participants were 2nd year students at the Faculty of Physical Education and Sports within the National University of Physical Education and Sports of Bucharest, aged between 19 and 22 years. Generally, they practice different types of sport, but approximately 40% of them are not involved in training or competitions. More precisely, 50 students (29 male and 21 female) performed the Distributive Attention Test, 43 students (25 male and 18 female) were evaluated with visual and auditory memory tests, while 51 students (30 male and 21 female) performed the Nonverbal Intelligence/Reasoning Test. We mention that almost 100 students were tested, but only those who had completed all courses in September 2016 (before starting the second year of study) were selected for the research.

5.2. Materials

The instruments used to explore the cognitive abilities of the students were: the Prague Distributive Attention Test (developed by the Psychotechnic Institute in Prague), the Visual Short-Term Memory Test, the Rey Auditory Test (Oprea, Nițu, Chiriacescu, & Lungu, 2003) and Abstract Reasoning Test (created by RQ Plus).

The Prague Test for Distributed Attention and resistance to mental fatigue requires participants to find randomly placed numbers (from 1 to 100). In the table test, each cell contains a pair of numbers. The task of the participant is to identify, within a limited time (16 minutes), a series of numbers and then to write the numbers that complete the pairs.

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The Visual Short-Term Memory Test requires memorizing geometric shapes. The participants have 1 minute to memorize 8 geometric figures. Then, within 2 minutes, they must recognize the figures in 24 different geometric shapes.

The Rey Auditory Test is an efficient neuropsychological instrument to evaluate short-term declarative memory, assessing new verbal learning. 30 words from different categories were read one time for the participants. Immediately afterwards, they had to write as many words as they remembered.

The Abstract Reasoning Test predominantly requires innate (fluid) intelligence/reasoning (independent of experience). The participants must identify the rules in order to solve the nonverbal problems. The test comprises 40 items (nonverbal situations that require solutions) and lasts about 30 minutes.

5.3. Procedure

In the research, the students were tested in groups of 5-21 people at a time (October-November 2016). The four tests used (Prague Distributive Attention Test, Visual Short-Term Memory Test, Rey Auditory Test and Abstract Reasoning Test) were carried out by the students within three weeks, from Monday to Thursday, from 8:00 a.m., 10:00 a.m., 12:00 a.m., 2:00 p.m. or 4:00 p.m. (depending on when they had classes at the university). In these conditions, the number of students varied from week to week. The four different tests assessing intellectual capacities were applied every time (with each group) in the same order. Thus, in the first week, 50 students performed the Prague Distributive Attention Test, in the second week, 43 students were evaluated with the VSTM and Rey Auditory tests, and in the third week, the Abstract Reasoning Test was administered to 51 students. We argue that, when evaluated, the participants were in a state of physical rest (without having performed previously any exercise) and in a relatively neutral mental state (they had not been previously exposed to positive/negative emotional stimuli). Ethical principles were ensured (Denscombe, 2014): the participants were treated with consideration, were free from any constraints, could stop a test if they wanted, and the results were confidential.

The performances achieved by the students in the Prague Distributive Attention, Visual Short-Term Memory, Rey Auditory and Abstract Reasoning tests were compared to the academic performance, more exactly, with the overall average of their grades/marks at the end of the academic year 2015-2016.

6. Findings

In the preliminary data analysis, we investigated the possibility of the existence of extreme values for the results obtained by the students in the four tests (perhaps because of fatigue or low interest). The box-plot charts showed no outliers.

To verify the degree of association between variables (results in the four tests and grades/marks obtained by the students), the Sommer's d-indicator was used. We have chosen this statistical indicator because of the asymmetric relationships between variables: the academic performance (the overall average of grades/marks) is considered to be the dependent variable, while the performance obtained by the students in the four tests represents the independent variable.

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6.1. Academic performance and short-term auditory memory

Table 01. Results for academic performance and Short-Term Auditory Memory Test (Rey)

			Short-Term Auditory Memory			Total
			High score	Medium score	Low score	
Academic performance	good - grades between 8-9	Count	10	4	2	16
		%	52.6%	30.8%	18.2%	37.2%
	medium - grades between 7-8	Count	7	5	5	17
		%	36.8%	38.5%	45.5%	39.5%
	low - grades between 6-7	Count	2	4	4	10
		%	10.5%	30.8%	36.4%	23.3%
Total		Count	19	13	11	43
		%	100.0%	100.0%	100.0%	100.0%

The data in Table 01 emphasise:

- Of the 19 students with high scores in the Rey Auditory Test, 10 (52.6%) obtained good grades, 7 (36.8%) recorded medium academic success (marks between 7 and 8), while 2 students (10.5%) had low grades/marks.
- Of the 13 students with medium scores in the Rey Auditory Test, 4 (30.8%) recorded good grades, 5 (38.5%) had medium grades/marks, while 4 students (30.8%) obtained low grades/ marks (between 6 and 7).
- Of the 11 students who obtained low scores in the Short-Term Auditory Memory Test (Rey), 2 (18.2%) recorded good marks, 5 (45.5%) had medium academic performance and 4 (36.4%), low academic results.

The Sommer's d-indicator is d = 0.300 and p = .014. Therefore, there is a significant positive association between variables. High scores in the case of short-term auditory memory are associated with better academic performance of the students who have obtained better grades/marks.

6.2. Academic performance and nonverbal intelligence/reasoning

Table 02. Results for academic performance and Abstract Reasoning Test (nonverbal intelligence)

			Nonverbal intelligence/reasoning			Total
			High score	Medium score	Low score	
Academic performance	good - grades between 8-9	Count	10	8	1	19
		%	66.7%	36.4%	7.1%	37.3%
	medium - grades between 7-8	Count	2	9	11	22
		%	13.3%	40.9%	78.6%	43.1%
	low - grades between 6-7	Count	3	5	2	10
		%	20.0%	22.7%	14.3%	19.6%
Total		Count	15	22	14	51
		%	100.0%	100.0%	100.0%	100.0%

The information in Table 02 highlights:

- Of the 15 students with high scores for nonverbal intelligence/reasoning, 10 (66.7%) obtained good grades/marks, 2 (13.3%) recorded medium academic success and 3 (20.0%) had low grades/marks.

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- Of the 22 students with medium performance in the Nonverbal Intelligence Test, 8 (36.4%) recorded good grades, 9 (40.9%) had medium grades/marks, while 5 students (22.7%) obtained marks between 6 and 7 (low academic success).
- Of the 14 students with low results for nonverbal intelligence, 1 student (7.1%) obtained good academic performance, 11 (78.6%) had medium academic performance and 2 (14.3%), low academic results.

The Sommer's d-indicator is d = 0.277 and p = .019. So, there is a significant positive association between variables, meaning that high results for nonverbal intelligence are associated with better academic performance of the students.

We specify that, in the case of visual short-term memory and distributive attention, no significant association with academic performance (the grades/marks recorded by the students) has been found.

7. Conclusion

The study demonstrates a significant positive association between cognitive skills and academic performance. More precisely, there is a significant positive association between the results for short-term auditory memory and the academic success of the students. High scores in the case of short-term auditory memory are related to better academic performance, students obtaining better general scores. This can be explained by the fact that students with good auditory memory remember information that has been presented orally and recall data that they have read to themselves (even silent reading involves a form of listening). As Cusimano (2001) said, it is important, for a good recall of the information, to pay attention and listen to our silent input of words. Tan (1999) argues that difficulties in the case of short-term auditory memory can impact on the social and academic development and can lead to frustration and diminished self-esteem. Knowing these, we must help students develop strategies to efficiently remember auditory information. First, students must listen actively: they need to have an alert posture, reduce excessive movements, look at the speaker, think about what the speaker is saying and ignore the background noise (students must think about how they listen - a metacognitive task). Next, students can use visualisation (making an internal visual image of what they have heard). Also, representations should not be limited to visual aspects, but may include what a person hears or feels (Predoiu, 2016). In addition, students can use rehearsal - repetition of the keywords, linking ideas and chunking (information is broken down into smaller parts that are easier to retain).

Through our research, we have also emphasised that there is a significant positive association between the performance for nonverbal intelligence (mostly fluid, innate) and the marks recorded by the students at the end of the first year of studies. Thus, high scores for nonverbal intelligence are related to better academic performance. Knowing that nonverbal intelligence is not entirely innate (independent of experience), students can be stimulated through specific training/programs, which enhance this type of intelligence.

We specify that in the case of visual short-term memory and distributive attention, no significant association with academic performance (the grades/marks recorded by the students) has been found. In addition to the revealed data, in order to improve the academic success of the students, we must underline the importance of teacher's expectations. The literature (Pânişoară, & Pânişoară, 2005) asserts that

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teacher's expectations are causes of student performance. If teachers have low performance expectations from their students, this leads to poor academic results of the students. The limits of our study are the cultural differences and the age of participants - we are aware that the findings could be different in another setting. Also, the testing period was not similar, the students being tested in the morning or in the afternoon and not the same day (they were investigated from Monday to Thursday, according to the moment they were at school).

Further research is necessary to reveal the effects of different mental and psychophysical skills upon academic performance. It is also important to study (besides nonverbal or fluid intelligence, visual short-term memory, short-term auditory memory and distributive attention), creativity, verbal intelligence, analogical reasoning abilities, personality traits (autonomy, anxiety, self-confidence, aggression, conscientiousness or sensation seeking) and psychomotricity (for example, speed and distance estimation, reaction time, conditional abilities such as endurance, speed, strength, coordination abilities such as coordination, balance, spatial orientation), considering that the participants are students at the Faculty of Physical Education and Sports.

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