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Artículo de Investigación

Recepción: 2 de febrero del 2016
Aprobación: 20 de abril del 2016

Praxis & Saber
Revista de Investigación y Pedagogía
Maestría en Educación. Uptc

RELATIONSHIPS BETWEEN LEARNING ACHIEVEMENT, SELF-MONITORING, COGNITIVE STYLE, AND LEARNING STYLE IN MEDICAL STUDENTS

Abstract

An analysis is presented of the relationships that exist between learning achievement, the use of metacognitive self-monitoring, cognitive style (Field Dependence-Independence dimension), and learning style (Grasha's Classification) in university students. The study was conducted with a population of 130 medical students enrolled from 6th to 10th semester in a university in Bogotá, Colombia. Using a bivariate correlation,associations were sought between the Grade Point Average (GPA) achieved by students, metacognitive self-monitoring, which was measured with the Motivated Strategies for Learning Questionnaire (MSLQ), cognitive styles, which were measured through the Embedded Figures Test (EFT), and learning styles as reported in the Grasha inventory. Findings showed positive correlations between learning achievement and the variables: cognitive style, use of metacognitive strategies, and participantand competitive learning styles, while negative correlations were found with avoidant and dependent learning styles. Similarly, other correlations were found between the studied variables, which are discussed in the document.

Keywords: learning achievement, self-monitoring, metacognition, cognitive style, learning style

Relaciones Entre Logro de Aprendizaje, Automonitoreo, Estilo Cognitivo y Estilos de Aprendizaje en Estudiantes de Medicina

Resumen

Se presenta un análisis de las relaciones que existen entre logro de aprendizaje, uso de automonitoreo metacognitivo, estilo cognitivo (dimensión Dependencia-Independencia de Campo) y estilo de aprendizaje (Clasificación de Grasha), en estudiantes universitarios. El estudio se realizó con una población de 130 alumnos de una facultad de medicina de 6º a 10º semestre en una universidad en Bogotá, Colombia. Utilizando la metodología de correlaciones bivariadas se buscaron asociaciones entre el promedio académico alcanzado por los estudiantes, el automonitoreo metacognitivo, medido con el cuestionario MSQL, los estilos cognitivos por medio de la prueba EFT y los estilos de aprendizaje reportados en el inventario de Grasha. Los resultados mostraron correlaciones positivas del logro de aprendizaje con las variables: estilo cognitivo, uso de estrategias metacognitivas, estilos de aprendizaje competitivo y participativo, y correlaciones negativas con los estilos de aprendizaje evasivo y dependiente. De igual forma se encontraron otras correlaciones entre las variables de estudio que son discutidas en el documento.

Palabras clave: logro de aprendizaje, automonitoreo, metacognición, estilo cognitivo, estilo aprendizaje.

Rapports entre Réussite D'apprentissage, Auto-Monitorat, Style Cognitif et Styles D'apprentissage Chez des Étudiants de Médicine

Résumé

On présente une analyse des rapports existants entre réussite d'apprentissage, utilisation d'auto-monitorat métacognitif, style cognitif (dimension Dépendance-Independence de Terrain) et style d'apprentissage (Classement de Grasha), chez des étudiants universitaires. L'étude a été faite avec une population de 130 élèves de la faculté de médicine du 6ème au 10ème semestre d'une Université

 ISSN 2216-0159 E-ISSN 2462-8603

à Bogotá, en Colombie. En utilisant la méthodologie de corrélations bivariées, on a cherché des associations ente la moyenne académique atteinte par les étudiantes, l'auto-monitorat métacognitif, mesuré avec le questionnaire MSQL, les styles cognitifs à travers l'épreuve EFT et les styles d'apprentissage reportés dans l'inventaire de Grasha. Les résultats ont montré des corrélations positives de la réussite d'apprentissage ayant les variables: style cognitif, utilisation de stratégies métacognitives, style d'apprentissage compétitif et participatif, et des corrélations négatives avec les styles d'apprentissage compétitif et participatif, et des corrélations négatives avec les styles d'apprentissage évasif et dépendant. On a également trouvé d'autres corrélations entre les variables d'étude qui sont discutées dans le document.

Mots clés: réussite d'apprentissage, auto-monitorat, métacognition, style cognitif, style apprentissage.

Relações entre logro de aprendizagem, automonitorização, estilo cognitivo e estilos de aprendizagem em estudantes de medicina

Resumo

Apresenta-se uma analise das relações que existem entre logro de aprendizagem, uso de automonitorização metacognitivo, estilo cognitivo (dimensão Dependência-Independência de Campo) e estilo de aprendizagem (Classificação de Grasha), em estudantes universitários. O estudo se realizou com uma população de 130 alunos da faculdade de medicina de 6º a 10º semestre em uma universidade de Bogotá, Colômbia. Utilizando a metodologia de correlações bivariadas procuram-se associações entre o promédio acadêmico alcançado pelos estudantes, a automonitorização metacognitiva, medido pelo questionário MSQL, os estilos cognitivos por médio do teste EFT e os estilos da aprendizagem reportados no inventario de Grasha. Os resultados mostraram correlações positivas do logro da aprendizagem com as variáveis: estilo cognitivo, uso de estratégias metacognitivas, estilos de aprendizagem competitivo e participativo, e correlações negativas com os estilos de aprendizagem evasivo e dependente. Igualmente, se encontraram outras correlações entre as variáveis de estudo que são discutidas no documento.

Palavras chave: logro de aprendizagem, automonitorização, metacognição, estilo cognitivo, estilo aprendizagem.

ISSN 2216-0159 E-ISSN 2462-8603

Introduction

For several years now, learning achievement has been associated to aspects of learners' environment and characteristics (Bandura, 1989, 1991, 2002). In this sense, a large amount of studies have been developed that involve novices' individual characteristics. On the one hand, cognitive style and its implications on learning processes has been studied (Alonso, 1992; Hederich-Martínez, 2004; López, Hederich-Martínez, & Camargo, 2011; Tinajero, Castelo, Guisande, & Páramo, 2011; Tinajero, Lemos, Araújo, Ferraces, & Páramo, 2012), and on the other hand, the effect of self-regulating abilities on academic success (Hederich-Martínez, 2011; López et ál., 2011; López, Hederich-Martínez, & Camargo, 2012). Apparently, a relationship exists between self-monitoring and learning style with goal achievement; however, the attempts to correlate them with each other have been scarce (López et ál., 2011, 2012). The underlying purpose of this analysis is to provide insight into all the relationships that might exist between learning achievement, self-monitoring as a metacognitive ability, cognitive style or information processing, and learning style, which is understood assubjects' preferences when they carryout learning tasks.

When specifically discussing the strategies that foster self-monitoring, positive relationships are reported with increases in learning achievement. Chang (2007) found a positive effect when implementing self-monitoring strategies in groups with low metacognitive levels, where the use of this strategy became a compensation mechanism of their weaknesses (Chang, 2007). A more detailed explanation of the relationship between the use of self-monitoring strategies and academic results has to do with an increase in the capacity to tolerate distractions. The research conducted by Anderson (2006) demonstrated a greater tolerance to interruptions when metacognitive self-monitoring strategies were used (Anderson, Oates, Chong, & Perlis, 2006).Recently, other studies on text comprehension evidenced an increase in student performance after using self-monitoring strategies (De Bruin & Van Gog, 2012; Thiede, Anderson, & Therriault, 2003).

In spite of the apparent benefit of implementing self-monitoring strategies, this behavior is used in a variable fashion in different educational levels (Lan, 2005). This is probably due to the individuals' stylistic characteristics, aspects that deserve to be studied in order to find some explanations.Lan (2005) found that only 20% of primary students self-monitor their strategies and

 ISSN 2216-0159 E-ISSN 2462-8603

results, and only 50% of postgraduate students implement self-monitoring strategies in their learning processes (Hsu, 1989; Lan, 2005). Zimmerman (1998) offers three possible explanations for this behavior:1) students may not be aware of the efficacy of self-monitoring, which reduces their interest to put it into practice; 2) students may not feel self-efficacy in the implementation of self-monitoring strategies, which discourages its use; and 3) students may have weak epistemological beliefs on learning, which reduces their intrinsic motivation (Zimmerman, 1998).

From a stylistic differences approach, it has been described that individuals have different ways of processing information when performing a learning task. These characteristics seem to be relevant since depending on the way in which the information is presented different achievement levels can be obtained (Cassidy, 2004). Specifically, cognitive style has been studied from a field dependence-independence dimension. In other words, if subjects prioritize external information, they depend onenvironmental factors (field dependents) or if they prioritize internal information, they process analytically and are self-referenced (field independents) (López et ál., 2011; Tinajero et ál., 2012). Several authors have studied the relationship between cognitive styles and learning achievement finding that field independent subjects exhibit betterperformances in the school environment and better results in visual and verbal oriented tests (Hederich-Martínez, 2011; López et ál., 2011; Tinajero et ál., 2011).

More recent studies on the relationship between cognitive style and learning achievement have not only confirmed field independent students' outstanding performance (López et ál., 2011, 2012; Tinajero et ál., 2012), but have also established a strong relationship between lower EFT scores and low academic results (Tinajero et ál., 2012). According to the findings made by Tinajero et ál. (2012), these results are related to motivational aspects and underutilization of planning and self-evaluation strategies (Tinajero et ál., 2012). This study demonstrated that at least 21% of academic results could be explained by the relationship between cognitive style and learning strategies. This finding would justify carrying out specific interventions to provide support to risk populations (field dependents) through strategies that foster self-regulating behaviors (Tinajero et ál., 2011).

With the purpose of analyzing the interaction of the mentioned variables, self-monitoring and cognitive style, some studies are mentioned that

ISSN 2216-0159 E-ISSN 2462-8603

demonstrate an empirical relationship between the field independent style and the implementation of self-regulated behaviors in specific areas, such as mathematics (López et ál., 2012). It is logical to think that this finding repeats itself in other circumstances and with other knowledge domains; although, as mentioned by Witkin (1977), depending on the environment, the subject's answers vary significantly and this makes up the cognitive style's defining characteristics (Witkin, Goodenough, & Oltman, 1979).This would explain why the same individual's behavior can change according to the environment's characteristics, but above all on the support strategies that they receive from the environment (Chou, 2001).

When looking further into the study of individual differences, we find the influence of the third variable of the present study on learning achievement, the learning styles (Cassidy, 2006; Grasha, 2002b). In specific populations, as in the study of Grasha (2002) –medical students- a significant relationship was found between learning styles and learning achievement, in this case, related to the manner in which the professors structured their teaching activities (teaching styles) and what it was like to work with peers (Grasha, 2002b).

Regarding the relationship of learning styles with self-monitoring as the basis of self-regulation, several studies were found that suggest significant links. In this sense, Cassidy (2006) found, in first-year university students, a positive relationship between deep learning style and self-evaluation abilities (Cassidy, 2006). In another investigation, Shannon (2008) found, in Chemistry students, a significant relationship between the use of metacognitive abilities (selection, critique, and revision of study material) and predominant learning styles -73% Kinesthetic and 45% Interactive.

In regards to the foregoing, the present study seeks to analyze the possible relationships between metacognitive self-monitoring strategies, cognitive style, and learning styles, with each other and as determinants of learning achievement in medical students.

Metacognitive monitoring and its relationship with learning achievement

In order to understand the analysis proposal of the present study, it is important to recognize metacognitive self-monitoring as the underlying element of the self-regulated learning cycle and possible determinant of

 ISSN 2216-0159 E-ISSN 2462-8603

learning achievement (Azevedo & Aleven, 2013; Greene & Azevedo, 2007; Griffin, Wiley, & Salas, 2013). Self-monitoring is present since planning, when the individual defines his or her personal goals and chooses the tactics and strategies (Winne, Jamieson-Noel, & Muis, 2002). It also allows defining the standards to which the individual will permanently compare the obtained results (Greene & Azevedo, 2007). This is basically, partial goal achievement and strategy utility monitoring. In response to this information the subject implements the necessary control actions (strategy and/or goal changes or adjustments) (Greene & Azevedo, 2007). According to Moos and Azevedo (2009),this type of monitoring could be the process that mediates the relationship between the subject's motivational and cognitive factors during the whole learning process (Moos & Azevedo, 2009).

The relevance of the implementation of metacognitive self-monitoring strategies is explained by several mechanisms. One of these is the discrepancy theory by Chang (2007), who reported that the students that exhibit better learning achievements continually monitor the differences between their current learning state and their desired state as a function of a predefined goal (Chang, 2007). Permanently performing this balance allows regulating the effort exercised in each phase of the learning process (Thiede et ál., 2003).

Another mechanism described as an explanation of the relationship of self-monitoring with academic results is related to the self-evaluation phase, in which attributional assignments are performed (Azevedo, 2009; Greene & Azevedo, 2007). At this moment, the student determines what was the cause of the good or bad results, concludes what he or she must correct, and from this he or she plans the next learning task.The implementation of metacognitive self-monitoring strategies at the end of the learning process has a positive correlation with learning achievement (Azevedo, Witherspoon, Chauncey, Burkett, & Fike, 2009; Greene, Moos, & Azevedo, 2011; Griffin et ál., 2013).

When reviewing contemporary pedagogical models applied to medical students, the emphasis of constructivist approaches is evident. In these, the student's role is more active and largely requires autonomy abilities for learning (Branda, 1990). Contrary to what could be thought, metacognitive self-monitoring abilities are not predominant in these students and when they have been experimentally promoted, positive results are evidenced in terms of learning achievement (Apeldoorn, 2009).

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Individual differences in relation to cognitive styles and learning styles

Since the second decade of the twentieth century, emphasis has been made on the recognition of novices' individual differences and its implications for educational program planning. This analysis' approach has been carried out from the cognitive and learning styles (Alonso, 1992; Curry, 1990; Hederich-Martínez, 2004, 2013; López et ál., 2011, 2012).In this sense, it is important to take into account some key aspects in order to understand its implications. In the first place, it is proposed that 'style' must be a differentiating characteristic, in other words, that it allows to typify each individual's behaviors and recognize them among other subjects (Alonso, 1992; Hederich-Martínez, 2013). In the second place, it is suggested that this category should be stable, which means that it must have a minimum level of durability, visible in the course of action, and it must allow the identification of a subject with certain behaviors (Alonso, 1992; Hederich-Martínez, 2013). In the third place, it is mentioned that it should be integrated. This proposes that it involve different dimensions of the individual and that it be perceived in different action contexts. Finally, that it be understood as having a neutral nature; it must not function to make hierarchical or discriminatory classifications that express absolute superiority levels of one style over another (Alonso, 1992; Hederich-Martínez, 2013).

Having once made the foregoing points, it is pertinent to clarify that when specifically referring to the style with which individuals perceive and process information adjusting their answer, what is being discussed is the cognitive style (Messick, 1993; Witkin & Goodenough, 1981). This concept has had great repercussions in education given that once students' particular characteristics are recognized, alternatives or strategies are configured, which sometimes are determinants of school success and other times of school failure (López et ál., 2011). Although diverse cognitive style evaluation proposals are recognized, for this study the field dependence-independence dimension was used (Witkin & Goodenough, 1981). An EFT was used in which a series of simple drawings embedded in other more complex ones are presented for the subject to try to find and identify. The theory claims that the capacity of deconstructing and constructing the complex figure determines the speed of response and with it, the cognitive style (Witkin & Goodenough, 1981). In this sense, there are two types of subjects: the field independents (FI) and the field dependents (FD). Field independents are characterized

 ISSN 2216-0159 E-ISSN 2462-8603

by making a more efficient use of short-term memory and they find the figure faster since they achieve restructuring at greater speed. In contrast, field dependents maintain irrelevant information in the work memory, which reduces the construction and deconstruction speed; therefore, they take longer solving the exercise (Pascual-Leone, 1989). It is important to highlight that although the EFT is perceptual, it mainly measures the positive response towards one pole of the dimension, while the opposite one is inferred; this difficulty has been studied without an apparent alternative that satisfies all of the expectations (Hederich-Martínez, 2013).

Regarding the third variable of analysis, the learning styles, which are understood as the 'preferences that individuals have to approach learning situations affecting performance and learning achievement'(Grasha, 2002b), a large number of studies have been conducted, some developing their own measurement systems or 'inventories'. Among the most renown are: the information processing group with the classification by Kolb (1984), (Accommodator, Divergent, Convergent, Assimilator, Experiential), the inventory of Honey and Mumford (1992) (Pragmatic, Active, Reflexive, Theoretical), and Biggs(2001), (Superficial and Deep); and the social interaction group that includes Grasha (2000) (Independent/Dependent, Participant/Avoidant, Collaborative/Competitive) (Cassidy, 2004).

Research that seeks to connect styles with academic achievement reach limited conclusions, among other reasons, because of the quantity of inventories or tests available to evaluate them; fortunately, there are integrated models that allow grouping them. Among these, Curry's onion model stands out (Cassidy, 2004; Curry, 1983). This researcher proposes a radial model with different depth layers that indicate the degree of style stability or variability in relation to external stimuli, where the outermost layers are defined as the most influenceable and the innermost as the most stable. In each one of these layers it is possible to locate the different theoretical postulates of the known authors (Brown, 2007). Located in the innermost layer is the cognitive style recognized as permanent or not modifiable, which according to Witkin,is classified into field dependent or independent (Witkin & Goodenough, 1981). The second layer reflects the information processing style and represents the most stable learning style models, of which Kolb is one of its most renown proponents with his experiential learning model (Kolb, 1984). The third layer refers to students' peer and teacher interaction, including Grasha's classification that involves the relationship with the environment

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(Grasha, 2002a). Also located in this layer are the instructional preferences, environmental or sociological, where the Dunn and Dunn inventory can be listed (E. Brown, Cristea, Stewart, & Brailsford, 2005; Cassidy, 2006).

For the purposes of this study, Grasha's (2000) approach was chosen since this author constructed the classification categories from the empirical findings that he obtained with large groups of medical students, he typified the manner how the students approached classroom tasks and activities, how they related to each other, and based on this, he characterized their learning styles (Grasha, 1972). The author proposed that within each student a mixture of several learning styles coexist; the majority of students evidence more than one style and the predominant characteristics are the ones that are expressed in their actions (Grasha, 2002b). Grasha coincides with other authors in that no style on its own is better than the others, each one has advantages and disadvantages, and the ideal strategy would imply achieving an adequate balance that takes into account the type of task to be performed and the environment (Grasha, 2002b).

Among Grasha's initial findings, he found that the majority of university medical students had underdeveloped abstract thinking or independent abilities (Grasha, 2002b; Grasha & Yangarber, 2000).Subsequently, his studies allowed to suggest that the students' stylistic preferences are a product of their previous experiences and that the adaptation of their learning strategies are in accordance to how the professor structures the class and their interaction with their classmates. This confirms the theory that learning styles are susceptible of being adjusted, at least partially as a function of the experiences. Such adaptation leads the student towards a condition called "state", in which the personal preferences are identifiable and they adapt to the circumstances (Grasha, 2002a).

Grasha proposes a learning styles classification based on three categories of analysis: 1) Student's attitudes towards learning; 2) Perception on classmates and professors; and 3) Reaction to didactic strategies in class (Grasha, 2002b).

From this categorization the following learning styles are defined (Grasha, 2002b):

1. Participant: Called 'good' students, enjoy the sessions, and try to be attentive most of the time. They have great willingness for classwork,

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volunteer for most of the activities, and complete both the mandatory and optional tasks. They exhibit leadership abilities.

2. Avoidant: They do not manifest enthusiasm in class, they do not participate, they keep themselves isolated most of the time, and they do not like to be called to participate. They are apathetic and uninterested in school activities and do not like spending a lot of time in the classroom. They avoid volunteering and prefer to go unnoticed.
3. Competitive: They study to prove to the rest that they are the best in terms of achievement and grades (rewards). They like being the center of attention and receiving recognition for their achievements. Their interest falls when there are no rivals to defeat. They seek strategies as a function of results, they want to be the best, and do not handle failure well.
4. Collaborative: They like to learn by sharing ideas and talents and they like to work with classmates and professors. They like to participate in-groupprojects. They frequently volunteer and do not feel comfortable working alone.
5. Dependent: They manifest a lack of intellectual curiosity and only learn the minimum of what is required of them. They have better results in models focused on the professor. Their epistemological beliefs on learning are weak and they have a hard time findingvalue in the task. They exhibit a lack of initiative, do not reflect on their learning, and prefer others to assume leadership.
6. Independent: They like to think for themselves, are self-motivated, and confident in their learning capacities. They decide what is or is not important, they like to work by themselves avoiding teamwork since they do not have great social abilities.

Although for some authors the concepts of cognitive style and learning style are equivalent and are separated mainly by the framework in which they are used –psychological for the cognitive style and educational for the learning style– (Hederich-Martínez, 2013), in this research differentiation is important. Important, firstly, because from the modification expectations that are attributed to the learning style different pedagogical interventions could be posed, and secondly, because the correlation of the two concepts greatly supports the recognition of the students' individual differences. In addition, it is anticipated that by having different style valuation mechanisms –perceptual for the cognitive style and self-reporting for the learning style- it is possible to find explanations to the relationship of these two constructs (Hederich-Martínez, 2013).

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In this research, two main questions are posited. In the first place, what relationship exists between learning achievement and the three psychological characteristics: metacognitive self-monitoring, cognitive style from a field Dependence-Independence dimension, and learning styles from Grasha's classification. In the second place,whether if the studied psychological characteristics are related to each other and what this relationship is like. The study was conducted with university medical students from a private university of Bogotá, who were studying the topic of "hemodynamic monitoring in adult patients', understood as the medical strategies that allow to continually evaluate the altered circulatory events in critical patients.

Methodology

This analysis was conducted through a correlational study in a population of 130 medical students; all the participants were enrolled in an elective course of hemodynamic monitoring of the adult patient. The population consisted of 106 women (81.5%) and 24 men (18.5%), with an average age of 22.55 years, ranging from 18 to 40 years old, and a standard deviation of 3.90. The applied tests and the gathering of information were conducted with prior informed consent of the participants and with the approval of the university's ethics commission.

Instruments

The following tests were applied to all the participants in the study:

1. Each student's cumulative GPA obtained from the university's official registration authority, represented by the grade points of all the semesters, in a scale from zero to 100.
2. Self-report MSLQ to evaluate self-regulating abilities developed by Pintrich (Pintrich, Smith, García & McKeachie, 1991). This test has demonstrated high reliability levels and for this reason it is applied in a large number of studies on self-regulation (López et ál., 2012). For the present study, the metacognition subscale that showed a Cronbach's alpha (12 metacognition items) of 0.787 was taken, which suggests a high level of internal validity.
3. EFT proposed by Sawa (1966) to determine cognitive style in the field dependence-independence dimension. It consists of a series of exercises, each page shows one simple figure and 10 complex figures, the subject must find and trace the outline of the simple figure within the complex figures, and the subject has a time limit controlled by an evaluator.

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4. Learning style evaluation test (Grasha-Reichmann Student Learning Styles Scale Inventory) developed by Grasha in 1974. It is a self-report Likert-type test of 60 items, with five answer options from "strongly disagree = 1' to "strongly agree = 5'. The 60 items are classified in six categories, each one with 10 statements. In this test, high internal reliability levels were found. It had a Cronbach's alpha of $\alpha = 0.850$ for the whole test and the following results were obtained for the categories: Independent, $\alpha = 0.565$; Avoidant, $\alpha = 0.786$; Collaborative, $\alpha = 0.695$; Dependent, $\alpha = 0.671$; Competitive, $\alpha = 0.835$; Participant, $\alpha = 0.654$.

Procedure

The process begins with the presentation of the research protocol, which is approved by the university's ethics commission without any objection. The students themselves input the demographic data when they enroll in the course. All the students sign the consent and present the tests (EFT, MSLQ, Grasha), before the experience is carried out. EFT is taken in person and the MSLQ and Grasha tests are presented online. The test results are exported from the MSQL database to an Excel template, and from there, they are imported to the IBM SPSS (Statistical Package for the Social Sciences) version 22 statistical software, with which a bivariate correlation analysis is conducted.

Findings

In Table 1, the descriptive statistics of the analyzed variables are shown. The mean of the variable prior academic achievement was 73.88 with a scale from zero to 100 and a standard deviation of 6.93. In the metacognitive strategies category, measured by the MSLQ, a mean of 4.27, ranging from one to seven, was reported, which is slightly superior to the median value that would be 3.5.

The cognitive style test (EFT) reported a mean of 30.2/50 with standard deviation of 8.02. The minimum value was 15 and the maximum 48 with a normal distribution. From the tertiles 33.3% and 66.6%, three interpretation ranges were created: tendency towards Field Dependent 31.5% of the population, tendency towards Field Independent 36.9% of the population and Intermediate 31.5% of the population (Table 1).

In the learning styles, predominance was found of the Collaborative style with mean value of 4.00, ranging from one to five, and median of 2.5, which

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suggests a clear tendency towards this stylistic profile. In second place is the Participant style with mean of 3.9, which is greater than the median and would complete the predominant stylistic profile in this student population. The styles that follow, in order, are: Dependent, mean 3.82; Independent, mean 3.69; Competitive, mean 3.36; and Avoidant with mean 2.25.The latter is clearly below the median, which suggests stylistic characteristics that are not very evident for this population (table 1).

Table 1

Mean and Standard Deviation Values of the Study's Main Variables

Variable	Category	Mean	Standard Deviation
Academic Achievement		73.88	6.93
Metacognition	MSLQ	4.27	0.67
Cognitive Style	EFT	30.28	8.20
	Collaborative	4.00	0.27
	Participant	3.92	0.41
Learning Styles	Dependent	3.82	0.34
(GRSLSS)	Independent	3.69	0.41
	Competitive	3.36	0.65
	Avoidant	2.25	0.64

Note: MSLQ (Motivated Strategies for Learning Questionnaire), EFT (Embedded Figures Test), GRSLSS (Grasha-Reichmann Student Learning Styles Scale Inventory).

Correlations between Learning Achievement, Metacognition, Cognitive Style, and Learning Styles

In Table 2, the Pearson correlation coefficients between learning achievement, metacognitive abilities, measured cognitive style, and learning styles are shown.

When analyzing the relationships of the study's variables, academic achievement shows positive significant associations with: 1) Metacognitive abilities (r = .24, p < 0.01); 2) EFT for cognitive style in the Field Dependent-Independent (FDI) dimension (r = .32, p < 0.01), and; 3) with Competitive learning style (r = .28, p < 0.01). In contrast, prior academic achievement has a negative significant association with the Dependent learning style (r = -.18, p < 0.05) (See table 2).

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Regarding the associations of metacognitive abilities reported in the MSLQ, a positive relationship, strongly significant is evidenced with Field Independent Cognitive Style (r = .68, p < 0.01), with Collaborative (r = .24, p < 0.01), Participant (r = .39, p < 0.01), and Competitivelearning styles (r = .59, p < 0.05). In contrast, a very strong negative relationship is evidenced with Dependent learning style (r = -.51, p < 0.01), and a less negative relationship with Avoidant learning style (r = -.23, p < 0.01) (See table 2).

Concerning the EFT cognitive style test, a strong positive association is evidenced with Participant (r = .43, p < 0.01) and Competitive learning styles (r = .71, p < 0.01). In contrast, a highly significant negative relationship is evidenced with Dependent learning style (r = -.55, p < 0.01).

With respect to the correlations of the learning styles between each other, a positive association is evidenced between the Participant and Competitive styles (r = .39, p < 0.01). On the other hand, negative associations are evidenced between the Dependent and Participant styles(r = -.250, p < 0.01), Avoidant and Participantstyles (r = -.158, p < 0.05), and the strongest in Competitive and Dependent styles (r = -.45, p < 0.01) (See table 2).

Table 2
Correlations between Learning Achievement, Metacognition, Cognitive Style, and Learning Styles

	Learning Achievement	Metacog-nition	EFT	Learning Style				
				Collabo-rative	Partici-pant	Depen-dent	Indepen-dent	Compe-titive
Metacognition	.24**							
EFT	.32**	.68**						
Collaborative	0.07	.24**	.17*					
Participant	0.14	.39**	.43**	0.10				
Dependent	-.18*	-.51**	-.55**	-0.12	-.25**			
Independent	-.02	-.04	.11	.01	.12	.01		
Competitive	.28**	.59**	.71**	.12	.39**	-.45**	.07	
Avoidant	-.06	-.23**	-.14	-.14	-.16*	.10	.05	.03

Note: Correlation is significant at the 0.01 level**, correlation is significant atthe 0.05 level*.

ISSN 2216-0159 E-ISSN 2462-8603

Discussion

As initially stated, the correlations between learning achievement and psychological variables, such as self-monitoring metacognitive abilities, cognitive style, and learning style, in medical students were reviewed.

Among the multiple significant correlations that learning achievement evidenced, two highly representative correlations must be highlighted; the first, occurs between learning achievement and (self-monitoring) metacognitive abilities, and the second, between learning achievement and cognitive style, each one of these will be reviewed below. In Figure 1, the variables correlations are presented; the continuous lines refer to positive correlations and the dotted lines refer to negative correlations.

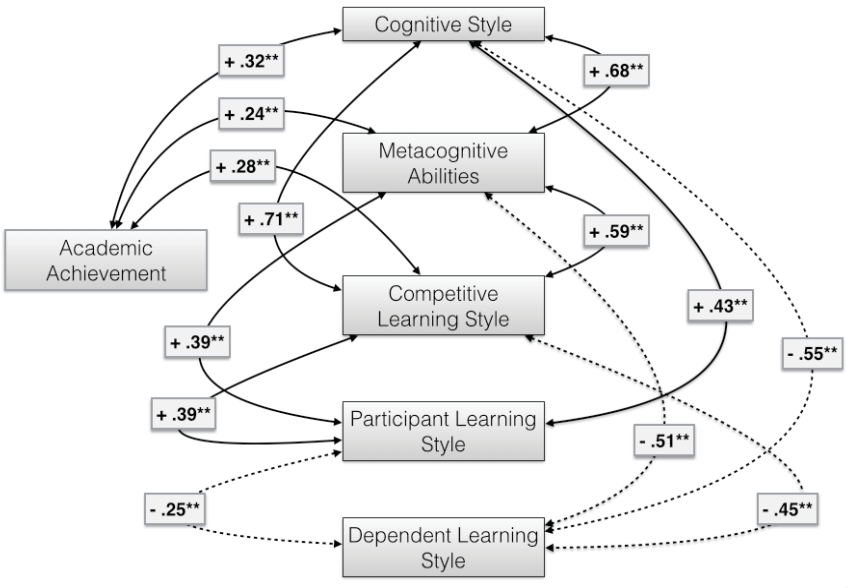

Figure 1. Correlation analysis model between Learning Achievement, Metacognitive Abilities, Cognitive Style, and Learning Styles. The continuous lines represent positive correlations and the dotted lines represent negative correlations, both with their significance levels. Correlation is significant at the $p<0.01$ level** and at the $p<0.05$ level*.

In the first place, it can be observed that the self-monitoring metacognitive abilities are strongly related to learning achievement. This coincides with prior publications of authors such as Azevedo (2009), who reported the association between self-regulating generic abilities like planning,

 ISSN 2216-0159 E-ISSN 2462-8603

cognition monitoring and control, and self-evaluation (Azevedo, 2009) and the relationship between self-monitoring and learning achievement (Moos & Azevedo, 2008). Apparently, this is explained by the development of great precision levels in the metacognitive judgments, greater strategy awareness, and on a secondary level, an increase in learning task success (Azevedo, 2009; Schraw, 2007, 2009).

From this study's findings, it could be interpreted that when medical students more frequently and precisely implement metacognitive strategies they achieve better learning results. These findings logically correspond with specific knowledge domain, as medical students mainly work with conditional knowledge, which is the basis for problem solving (Turan, Demirel, & Sayek, 2009).

In the second place, the strong correlation found between learning achievement and cognitive style is noteworthy. This finding has already been reported by several authors, not only as a positive correlation with better learning achievements (Hederich-Martínez, 2011; López et ál., 2011, 2012; Tinajero & Páramo, 2013), bust also when it is negative with low performances. In the latter sense, Tinajero (2012) found that university students with a greater tendency towards field dependence had the worst learning results, suggesting that this variable is important when planning support strategies for populations at risk for school failure (Tinajero et ál., 2012). Additionally, the present study's reports coincide with Hederich (2011), who not only confirms the positive relationship between the two variables, but also evidences a differential and progressive effect of this association since the field independent subjects have better learning results than the intermediate subjects, and these in turn, have better results than the field dependents (Hederich-Martínez, 2011).

Regarding the learning styles, Grasha's findings in medical students are confirmed with respect to a strong association between academic success and Competitive learning style (Grasha, 2002b). This also confirms that reported by Cassidy (2004) and Grasha (2002), who claim that learning styles are largely adaptation phenomenal to teaching strategies (Cassidy, 2004; Grasha, 2002a, 2002b). It is logical to find that medical students report stylistic competitiveness preferences since they are behaviors traditionally seen and even fostered among this discipline's professionals (Grasha, 2002b). In contrast, the negative correlation with the 'dependent'

ISSN 2216-0159 E-ISSN 2462-8603

learning style drives students away from academic success and puts them at risk for school failure. With respect to the latter, it must be highlighted that in this discipline, specifically the education model of the students that participated in this investigation (Problem-Based Learning), the role required of the student requires characteristics such as initiative, leadership, and autonomy. However, it becomes essential to develop pedagogical strategies that address the fact that the dependent students are at a disadvantage in this type of pedagogical models (Branda, 1990).

Other interesting associations

In the studied population, a positive association was found between metacognitive abilities and cognitive style. This relationship can be explained since the field independent students have a greater ability to monitor and control their actions insofar as they possess a greater analytical capacity with respect to the learning process and can follow-up on the planned strategies (López et ál., 2012). The metacognitive capacity of monitoring chosen strategies and adjust according to the results is correlated to the characteristic possessed by the field independents, who prefer to determine their own goals, choose their own course of action, and adjust the strategies according to the results (Hederich-Martínez, 2007; López et ál., 2011).

Another interesting correlation was found between metacognitive capacity and some learning styles. The strongest association was evident with the Competitive style. If we resume the correlation analysis between metacognition and cognitive style, it is possible to establish a triangle of strongly significant association between metacognitive abilities, field independence cognitive style, and Competitive learning style (Figure 2). It could be claimed that students with a Competitive learning style support their learning preferences with processing schemes of an analytical type. This happens when they define their own final and partial goals; determine their own cognitive and metacognitive strategies; when they use previous experiences and generate their own sources of motivation with the purpose of: being successful, standing out in their environment, and achieving the best academic performance versus their peers. If we take into account that this group of students reaches high learning achievements, the configuration of the model of the student with the largest probability of success in Medicine could be posited.

 ISSN 2216-0159 E-ISSN 2462-8603

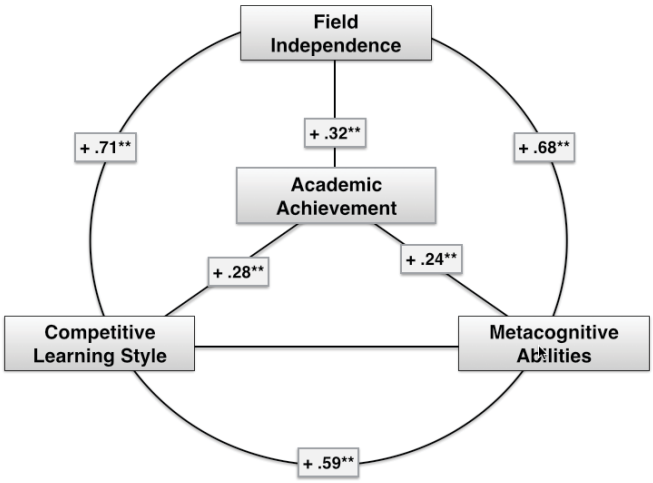

Figure 2. Correlations triangle model between Cognitive Style, Competitive Learning Style, and Metacognitive Abilities, with each other and of each one of these variables with Academic Achievement. Correlation is significant at the p< .01* level and at the p< .05** level

Similarly, although not as strong, a significant association between the mentioned variables (Field independence cognitive style and metacognition) and two learning styles, the Collaborative and Participant styles, was found. These two association triangles, which could be called secondary, have correlations that are not as strong and must be analyzed insofar as both learning styles show a strong correlation with learning achievement. It is possible to explain this association through the social interactions and teamwork that this discipline's students must undertake. In Medicine, a large portion of the performance is conducted collaboratively; these are abilities that receive recognition and are preferred by professors and students. Once again, the environment's influence gains relevance when the stylistic preferences of specific groups of students are studied, as well as when planning pedagogical strategies (Bandura & Jourden, 1991; Grasha, 2002b; Hederich-Martínez, 2013).

Negative Relationships

As it is known from the publications of López (2011, 2012) and Hederich (2004, 2007), the relationship between 'field dependence' cognitive style and low 'learning achievement' has been extensively demonstrated (Hederich-Martínez, 2004, 2007; López et ál., 2011, 2012). This study

ISSN 2216-0159 E-ISSN 2462-8603

documents the negative empirical relationship of the Dependent learning style with the cognitive style (r = -.55 p < 0.01), with self-monitoring metacognitive abilities (r = -.51 p < 0.01), with Participant (r = -.25 p < 0.01), and Competitive learning styles (r = -.45 p < 0.01).This would allow establishing a more precise description of the field dependent populations according to the FDI dimension and with the Dependent learning style according to Grasha.

As can be extracted from the presented data, the relationships between learning achievement, self-monitoring metacognitive abilities, cognitive style, and learning styles possess a high level of complexity. Research studies have contributed insight into these relationships, but there is still an urgent need to develop more in-depth analyses and studies that allow the design of pedagogical strategies that boost students' strengths and minimize the effect of their weaknesses (Tinajero et ál., 2012).

Limitations and Recommendations

It is necessary to mention that the present study was conducted under conditions that could become limitations for the generalization of its conclusions. In the first place, the number of students is not ideal. In a subsequent test, a larger population that allows generalizing the results to other university students should be used. In this sense, it must be clarified that the population is only of medical students. Consequently, the scope of the conclusions must be limited to similar populations. It is important to clarify that the students of this university are exposed to a methodology that requires greater skills for autonomous learning; hence, it could be expected to find differences with similar populations that use other methodologies.

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