Article ▸ Visual Spatial Relationships and Processing Speed In University Students

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ABSTRACT

Background: The purpose of this study was to compare the Visual Spatial Relationship and Processing Speed of students in first and tenth semesters of Architecture and Law of the Autonomous University of Aguascalientes.

Methods: The PMA (Primary Mental Abilities) test was implemented for Visual Spatial Relationship and Processing Speed to 80 students.

Results: Architecture students have better-developed Visual Spatial Relationship and Processing Speed than Law students. Architecture students in the tenth semester showed better results than those in the first semester. The t-test showed that there is a statistically significant difference of Visual Spatial Relationship (p=0.03) and Processing Speed between the students of Architecture and Law (p=0.00).

Conclusion: The students of Architecture presented a better performance in Visual Spatial Relationship and Processing Speed throughout their university studies in comparison to Law students. Students of Architecture and Law develop VSR and PS throughout their career. At the beginning of each career, both VSR and PS are equally developed in students. Considering VSR as a quality index for professional practice, it is evident that it is an important ability for the architect. Without a doubt, VSR and PS are significant abilities in Architecture and law.

Keywords: processing speed, students, visual spatial relationships

Introduction

Spatial cognition is the process of creating psychological structures through which the human being acquires, codifies, and decodes information received from their surroundings.[1] These structures form the relative distances and directions linked within the different elements of the environment.[2] Therefore, knowing the physical surroundings implies that human beings are capable of constructing cognitive schemes from the information obtained from the environment.[2] On the other hand, vision is dynamic and changes rapidly, but the brain requires time to process information received visually.[1,2]

According to Scheiman, perception is the ability to locate and to obtain information from the environment in order to integrate it with other modalities and major cognitive functions. Human knowledge not only requires sensible capture as a starting point, but it is the constant reference in which abstract concepts become tangible.[3] That is, the mental representations that people can make from physical objects, relationships and concepts, etc.[4] Gardner mentions that students have different types of minds with distinct potentials, interests, and different types of processing information that determine the individual ability to learn. For this reason, it is expected that students of Architecture have better development in their visual spatial

abilities, while the students of Law develop better in processing speed.[5]

Spatial capacity or the ability to visualize or to generate 3-D shapes of buildings, their interiors, and exteriors are synchronized with learning by observing, when it is related to learning models and the generation of three-dimensional shapes in an iconic manner.[1] For this reason, spatial capacity or visual spatial relationship is an ability that must be developed in future architects. Spatial capacities are cognitive functions that allow humans efficiently to create spatial relations, visual spatial works, and the orientation of objects in space.[2] On the other hand, students of Law have been portrayed as having better processing speed because it can be a predominant element for their success. Studies have demonstrated that it is important to have previous knowledge for the efficient reading of a text, and other factors like processing speed are taken into consideration.[6]

No previous studies were found that link profession and the development of specific perceptual abilities. Previous studies show that cognitive competence can be considered as a level of general intelligence or as a group of specific abilities tied to a general factor, and that one's own field that can be a good predictor of performance.[7] Saorin's work found a relationship

Table 1. Description and Classification of the PMA Subtests

PMA Subtest	Description	Classification
Visual Spatial Relationship	Allow the development of spatial concepts that are internal and external and are helpful to organize the environment	Very high: 80 – 100 High: 60 – 79 Medium: 40 – 59 Low: 20 – 39 Very Low: 0 – 19
Processing Speed	Amount of time it takes for an individual to analyze and interpret information	Very high: 80 – 100 High: 60 – 79 Medium: 40 – 59 Low: 20 – 39 Very Low: 0 – 19

Table 2. Distribution of Age and Gender of Students of Architecture and Law

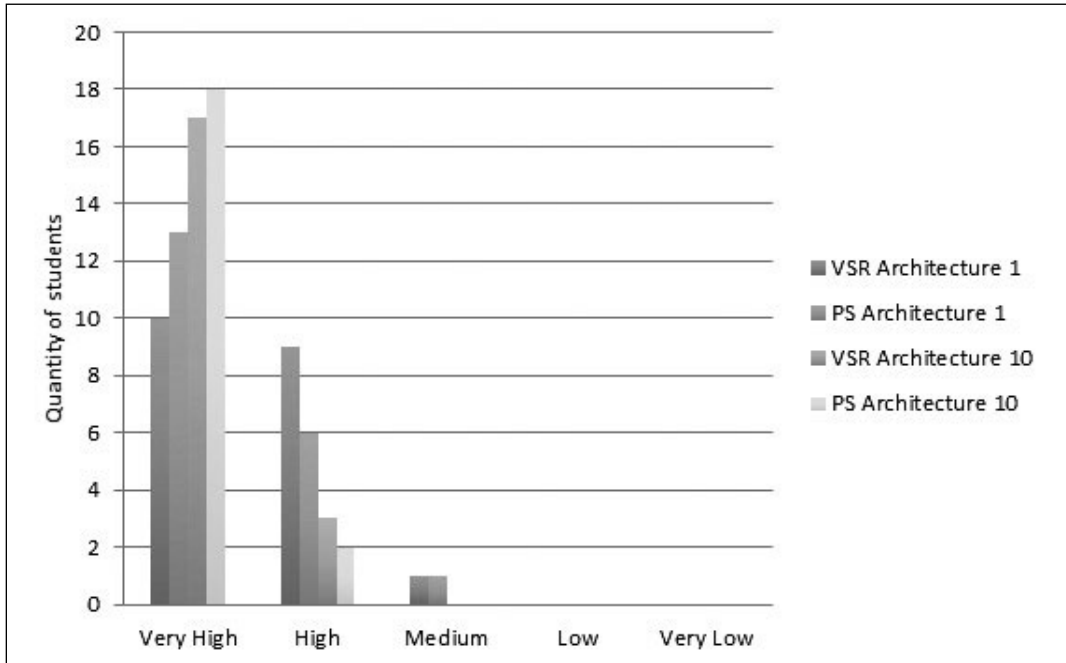| Career	Gender	Age = mean	# of students
Architecture First	M F	18 18	9 11
Architecture Tenth	M F	23 23	12 8
Law First	M F	20 19	14 6
Law Tenth	M F	24 23	10 10

Figure 1. Comparison of VSR and PS between students in first and tenth semester of Architecture
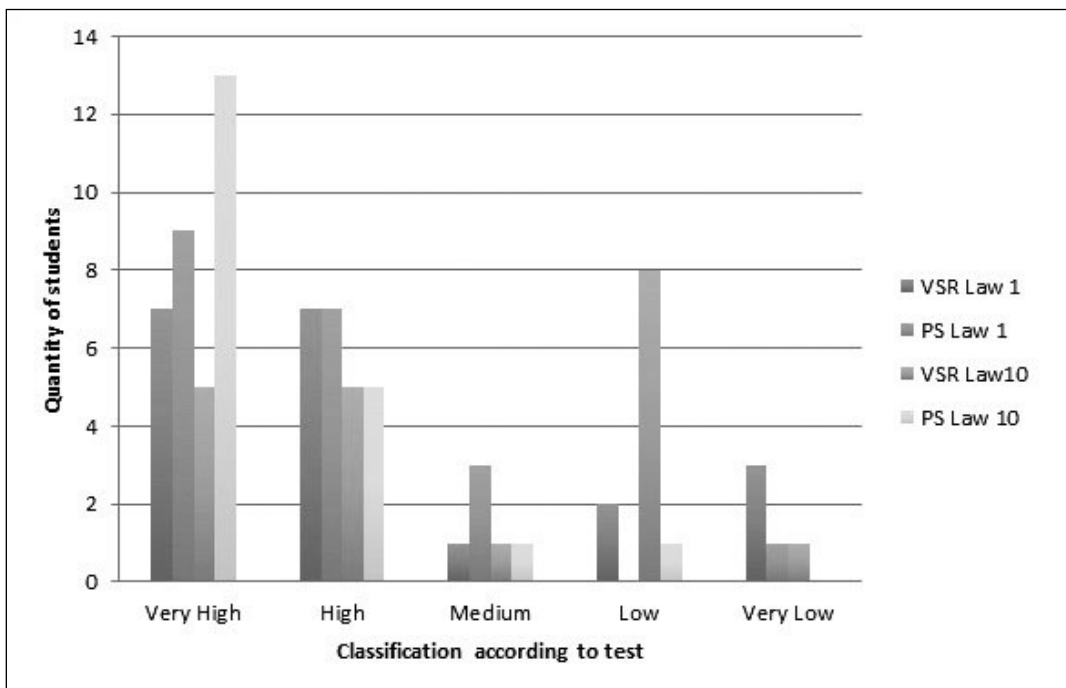

Figure 2. Comparison of VSR and PS between students in first and tenth semester of Law

between engineers and abilities. Engineers, and those linked to graphic expression, have been investigated since the beginning of the century in regard to visual spatial relationships.[8,9] The purpose of this study was to investigate the development of visual perceptual skills in the areas of Spatial Relationship and Processing Speed in Architecture vs. Law students.

Materials and Methods

An observational, analytical study was conducted. The study population was made up of students from the Autonomous University of Aguascalientes enrolled from January to June of 2015. Eighty-two were enrolled in Architecture, and 86 were studying Law. Architecture students were as follows: first year: 36 total, equal in gender; final year: 46 total, equal in gender. Law students were as follows: first year: 20 males and 19 females; final year: 24 males and 23 females. The study adhered to the Declaration of Helsinki and was approved by the review board of the college.

Eighty students were selected randomly from the previously mentioned careers (20 Architecture students in the first semester, 20 Architecture students in the tenth semester, 20 Law students in the first semester, and 20 Law students in the tenth semester). The mean age was 21 years old (range= 18-29). The exclusion criteria were students who decided not to participate and those who decided not to complete the test.

The PMA (Primary Mental Abilities) test[10,11] subtests for Visual Spatial Relationship (VSR) and Processing Speed (PS) were administered. The test took place in a quiet, illuminated classroom and was administered by three instructors. The VSR subtest requires the individual mentally to manipulate the parts of a square. An incomplete square is shown, and one must identify which of the four possible answers completes the square. The correct answer may or may not be in the appropriate spatial orientation, and the patient must mentally rotate the parts to determine the correct answer. The test has 25 questions and is done for 6 minutes. The number of correct answers are reported (raw score), and the total is converted to a standard score using the corresponding table according to the age group (the highest age group was taken). The percentile was then obtained. Statistical analysis of data was performed using a Student´s t-test by related differences. The results were classified as shown in Table 1.

For the PS test, one must identify similarities between images. The individual is asked to observe the figures in each row and select the two that are identical. Four examples are shown first, and once the test is comprehended, one must answer 40 questions with a time limit of 5 minutes. The results are calculated the same as the VSR test. Both subtests are stopped once the time for each is fulfilled.

Results

Distribution of the population according to age and gender is shown in Table 2. VSR and PS abilities were compared between the students of first and tenth semester of Architecture (Figure 1). The level of VSR in both groups is inferior to the PS ability. There is a perceived increase in both VSR and PS abilities in the students of tenth semester compared to those of first semester.

The VSR and PS abilities were compared between the Law students in their first and tenth semesters (Figure 2). It was observed that students in both the first and tenth semesters of Law have lower levels on the VSR compared to the PS, but there is a significant increase in the level of PS in students in the tenth semester compared with VSR ability.

VSR and PS were compared between the students of Architecture and Law in the first semester, as shown in Figure 3. We found very-high-level VSR in 10 students from Architecture, while very-high-level PS was found in 13 students; 7 Law students were very-high-level in VSR and 9 were very-high-level in PS. In high-level VSR, we found 9 Architecture students and 7 Law students. There were 6 students from Architecture with high-level PS and 7 Law students with high-level PS. There is not a significant difference between the abilities in both careers, but PS appears to be more developed in comparison to VSR.

Figure 4 shows the comparison between VSR and PS abilities in Architecture and Law students in the tenth semester. We found very-high-level VSR in 17 Architecture students, while in Law there were just 5 students. In PS, 18 students from Architecture showed very-high-level, compared to 13 in Law. The students in tenth semester of Architecture had a superior level in both VSR and PS in comparison to Law students. Law students have a lower level of VSR than PS.

Summarizing the findings (Table 3), we found significance between: Architecture (PS) first year v. Architecture (PS) last year, (p< 0.021), Law (PS) first year v. Law (PS) last year (p<0.000), Architecture (VSR) first year v. Law (VSR) first year (p<0.003), Architecture (VSR) last year v. Law (VSR) last year (p<0.000), and Architecture (PS) last year v. Law (PS) last year (p<0.000).

Discussion

This is the first study completed in Mexico that evaluates VSR and PS in University students. We compared the perceptual abilities of Architecture and Law students at the beginning of their career and in their last semester. According to Vazquez and Noriega, it is important to acknowledge that University students begin their studies with spatial capacity reasoning[7] that can be categorized as limited. This allows for growth in this area throughout their University experience, especially in technical careers. It should also force the teaching methods of preparatory schools to be examined further,[12] especially if it is known that having spatial abilities is linked with the capacity of giving representative content of spatial relationship visual concepts.[13]

Therefore, we have found that students of Architecture and students of Law currently in the tenth semester have higher levels in these perceptual abilities in comparison to those in their first
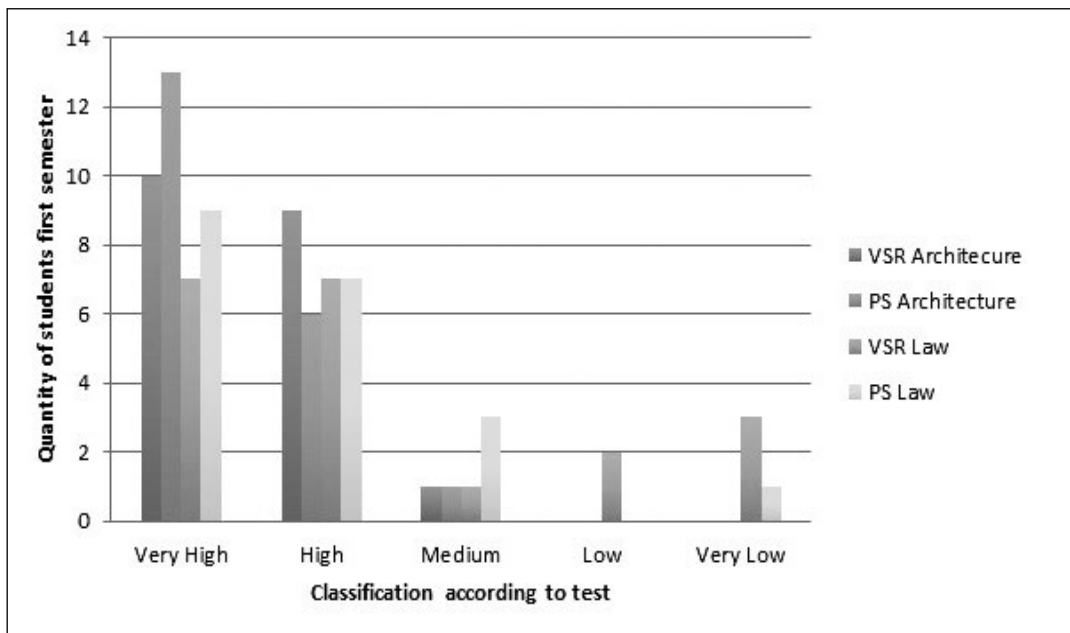
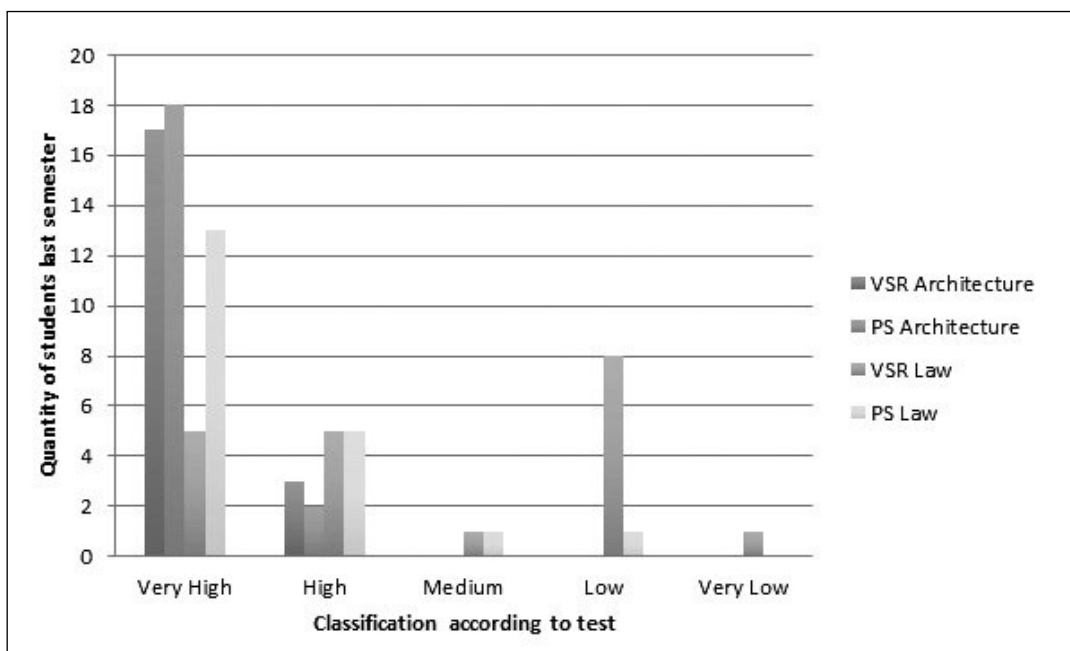***Figure 3.*** *Comparison of VSR and PS between students in Architecture and Law in first semester*

Figure 4. *Comparison of VSR and PS between students in Architecture and Law in tenth semester*

Table 3. Distribution of Age and Gender of Students of Architecture and Law

Groups: Arch and Law, first and last year. Skills: VSR and PS	Significance (bilateral)
Arch1VSR - Arch10VSR	0.226
Arch1PS - Arch10PS (*)	0.021
Law1VSR - Law10VSR	0.656
Law1PS - Law10PS (*)	0.000
Arch1VSR - Law1VSR (*)	0.003
Arch1PS - Law1PS	0.210
Arch10VSR - Law10VSR (*)	0.000
Arch10PS - Law10PS (*)	0.000

semester. This development can be considered to be an effect of the learning throughout their University experience.[14,15] The student's stay throughout their entire career allows for these perceptual abilities to develop. This coincides with Vazquez's work that found significant differences in the level of spatial reasoning between the start and finish of different careers.[16,17]

The students in their last semester of Architecture, in comparison to Law students in the same semester, show better development of both VSR and PS. According to Smith, some students possess a low Visual Spatial Relationship ability, which does not allow for the construction of structured images in comparison to those students with a high VSR ability.[18,19] The ability to create and appreciate analogies in language and

to generate visual spatial models that can be coordinated with a text are cognitive characteristics of individuals who desire to succeed in jobs that require spatial abilities.[19,20] Smith's work was corroborated by this study because Architecture students obtained high levels in both of the perceptual abilities tested.[19]

Conclusion

The students of Architecture performed better in VSR and PS throughout their university studies compared to Law students. Students of Architecture and Law develop VSR and PS throughout their career; both VSR and PS developed. Considering VSR as a quality index for professional practice, it is evident that it is an important ability for the architect. Without a doubt, VSR and PS are significant abilities in both the fields of Architecture and Law.

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