

Criteria and Instruments for Doctoral Program Admissions

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Abstract

Graduate studies, and in particular doctoral ones, pursue the development of scientific researchers able to make original contributions in a specific area of knowledge. However, attrition rates indicate that achieving this goal is not easy. The available evidence indicates that there are behavioral factors, positive and negative, that influence obtaining a doctoral degree. Unlike in other western nations, such as the USA, these factors have not been studied in Mexico. In particular, this article analyzes the relationship between academic success and the instruments commonly used to decide admission to undergraduate (EXANI-II) and postgraduate studies (EXANI-III) in Mexico. Additionally, a number of measurable psychological constructs are introduced. These constructs are different from those comprising the EXANI and can be used for admission to doctoral studies, to reduce attrition rates and increase the certainty about the timely completion of Doctoral dissertations.

Keywords: EXANI-II, EXANI-III, intellectual quotient, graduation rate, academic achievement, predictive validity, self-sabotage, grit, self-discipline, achievement goals, creativity.

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Criterios e Instrumentos para la Admisión en los Estudios de Doctorado

Resumen

Los estudios de posgrado, en particular los de doctorado, están orientados a la formación de investigadores capaces de hacer contribuciones originales dentro de un área de conocimiento. Sin embargo, las tasas de abandono o deserción indican que lograr este objetivo no es tarea fácil. Los estudios realizados indican que existen factores de comportamiento, positivos y negativos, que influyen en la obtención del grado de doctor. En México, a diferencia de los países anglosajones, estos aspectos han sido muy poco estudiados. En este artículo se analiza la relación entre el éxito académico y los instrumentos comúnmente utilizados para justificar el ingreso a los estudios de licenciatura (EXANI-II) y a los de posgrado (EXANI-III) en este país. Adicionalmente, se introducen una serie de constructos psicológicos medibles, diferentes a los que comprenden los EXANI, que pueden utilizarse para la admisión a estudios de Doctorado y aumentar la certidumbre en los índices de titulación a través de tesis originales defendidas en los tiempos establecidos para ello.

Palabras Clave: EXANI-II, EXANI-III, coeficiente intelectual, eficiencia terminal, éxito académico, validez predictiva, auto-sabotaje, valor, autodisciplina, propósito, creatividad.

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Introduction

Since 1970, Mexico has had an increase in enrollment in higher education, being the postgraduate level the one with the highest growth (Esquivel & Rojas, 2005). Additionally, since the early 1980s, the Mexican educational policies are formulated from concepts such as academic excellence, quality of education and completion or graduation rate¹ (Sevilla, Martín & Guillermo, 2009). Sponsored by the World Bank and the International Monetary Fund, these ideas have their origin in the efficient flow and management of materials and manpower for the manufacturing of quality products on schedule (Kannan & Tan, 2005; Watson, Blackstone & Gardiner, 2007). Therefore, they do not seek any achievement or improvement in the cognitive (Greeno, Collins & Resnick, 1996), pedagogical (Leach & Moon, 2008), philosophical (Phillips et al., 2010) or design (Gagné et al., 2005) aspects of Education.

From all the aforementioned concepts, perhaps one of the most important for the Mexican postgraduate programs (i.e., Master's or Doctorate) is the one denominated *completion rate*, also called by some scholars as *academic success* (Martínez et al., 2003; Sevilla, Martín & Guillermo, 2009). Proof of this is that the National Council of Science and Technology (CONACYT), through the National Program of Quality Postgraduate Programs (PNPC), states that according to their quality level, postgraduate programs must meet the following graduation rates by cohort (CONACYT, 2013): a) developing postgraduate programs: 40%; b) consolidated postgraduate programs: 50% and c) international postgraduate programs: 60%.

The definitions for the term graduation rate abound (de los Santos, 2003; Colonia, 2010). However, all of them refer to the number of students who obtain an academic degree, within the time frame set by a syllabus or curriculum, and with the quality standards defined by a particular educational institution. For the Mexican postgraduate programs, and particularly for those belonging to the PNPC, one of the implications of using the concept of graduation rate is that special care must be taken during the selection or admission process, in order to ensure that the applicants admitted obtain the degree within an established time period, thus ensuring permanence within the PNPC (Sevilla, Martín & Guillermo, 2009; Solís, 2009). In spite of this, in Mexico this topic has received little attention. Proof of this is that in the last

¹ Eficiencia terminal in Mexican Spanish.

book published by the Mexican Council of Postgraduate Studies (COMEPO), from 41 articles only 2 (Maya, Chávez & Apolinar, 2012; Pérez, Serna & Barriga, 2012) address the admission process to postgraduate programs and they do it tangentially. In particular, they only mention the admission criteria (i.e., minimum score on the National Test for Postgraduate Admission or EXANI-III), undergraduate grade point average (GPA) and score on the TOEFL (Test of English as a Foreign Language). There is not, in these papers, a review of the literature or a statistical analysis to help determine the relationship and impact of these criteria on the concepts of graduation rate, postgraduate GPA, research productivity or other important variables for the postgraduate programs.

While the admission processes to postgraduate programs, their criteria, and the impact they have is a topic that it is not addressed by the Mexican scientific community, in the United States of America (USA) this subject has been widely studied. In particular, the use and impact of the so-called *standardized admission tests* (Kuncel, Hezlett, & Ones, 2001; Kuncel, Hezlett, & Ones, 2004; Kuncel & Hezlett, 2007; Kuncel, Wee, Serafin, & Hezlett, 2010), as the main criterion for admission to institutions of higher education (IHE) has been the subject of scrutiny and debate since the early twentieth century (Kaufman, 2013).

The results of the most recent meta-analyses (Kuncel & Hezlett; 2007; Kuncel et al., 2010) indicate that standardized tests applied in the USA, in particular the *Graduate Record Examinations* (GRE-T), the *Graduate Management Admission test* (GMAT) and the *Miller Analogies test* (MAT) are the best predictors of research productivity, citation count and degree completion, with correlations ranging from 0.120 to 0.220. These correlations even though they are positive, are still low. Therefore, a scientific movement has emerged in order to complete the psychological puzzle of academic success, by identifying and analyzing other admission criteria different from standardized tests, that at the same time, have a less adverse impact on applicants from ethnic minorities or from a low socioeconomic status (Atkinson & Geiser, 2009; Busato et al, 2000; Chamorro-Premuzic & Furnham, 2003, Duckworth et al., 2007; Kaufman, 2010; Poropat & Kyllonen, 2009; Kyllonen, Walters, & Kaufman, 2005; Sternberg, Bonney, Gabora, & Merrifield, 2012; Tomsho, 2009).

Aims

Therefore, this paper has two aims or objectives. First, from a literature review, to analyze the level of predictive validity of the standardized tests administered by the National Center for Higher Education Evaluation (CENEVAL) for admission to undergraduate (i.e., EXANI-II) and Postgraduate (EXANI-III) studies in Mexico. Second, to establish a minimum set of individual characteristics or qualities for applicants to doctoral studies, different from those considered in the aforementioned tests, related to success in postgraduate studies (i.e., in particular obtaining the academic degree), which are measurable and that are not detrimental to applicants from ethnic minorities and from lower socioeconomic strata.

The rest of this paper is organized as follows. First, the predictive validity of the EXANI II and III is analyzed through a review of the existing literature on the topic. Second, the main goals of doctoral studies are established and, two explanatory models of success in such studies are described, stressing the importance that in both models have, the individual characteristics of doctoral students. Third, some of the most studied individual characteristics in the literature, relevant to the objectives of a doctoral program, are presented and justified. Finally, some conclusions and future work are presented.

Standardized Admission Tests

Before analyzing the existing literature on the predictive validity of standardized admission tests to undergraduate and postgraduate programs in Mexico, it is necessary to answer the following questions: a) what is the origin of standardized tests? b) What do they measure? c) What are the statistical criteria used to build them? d) What people are considered as gifted or talented, with respect to the results of these tests?

The use of tests to determine the admission or rejection of a person, to what Lohman (2005) calls "educational opportunity", is not new. In Mexico, these tests were first used in 1994 to justify the admission or rejection to undergraduate studies (Hernández, 2007). In the United States, according to Kaufman (2013), these tests have been used since 1911. Their original purpose was to determine the mental age of a person (Boake, 2002), not the absolute level of intelligence or the probability of success in academia or professional employment. Nonetheless, these tests ended up being used as an instrument to justify the rejection and

punishment of the "undesirable" or "mentally weak" members of American society (Kaufman, 2013).

In particular, these tests measure one or more of the following domains or cognitive abilities: reasoning, spatial ability, memory, processing speed and vocabulary (Deary, Penke & Johnson, 2010). The measurement of these skills involves the use of the working memory (Jaeggi, Buschkuhl, Jonides & Perrig, 2008; Kaufman, 2013; Thompson & Gray, 2004), which is a neural network or system that keeps information in mind (storage) and manipulate it (executive functioning) despite the potential for distraction or interference (attention). Consequently, as Colom, Rebollo, Palacios, Juan and Kyllonen (2004) point out, these tests do not measure specific knowledge or problem solving skills or strategies, but the differences between individuals when processing information.

Since they are influenced by the Wechsler-Bellevue intelligence scale (Boake, 2002), these tests are based on a set of arbitrary statistical decisions. Following Kaufman (2013), the first of them is the selection of the average Intellectual Quotient (IQ). Wechsler choose 100 as the average person's IQ because this number had become quite common in the original formula for calculating the IQ developed by Terman (1917). This value is equivalent to the (theoretical) mean for the EXANI II and III (CENEVAL, 2013a; CENEVAL, 2013b). Other tests administered by the CENEVAL, such as the Licensing Exam or EGEL test (López & Flores, 2006), have the same mean. The second decision is the use the concept of standard deviation, simply because it allows examiners to place the IC on a bell curve, which represents a normal distribution. The third and final decision was to use 15 as the standard deviation. This was because this represents the age at which Terman and Merrill (1937) considered that IQ scores stopped increasing, although they never actually tested anyone older than 18. Statistically, all these choices mean that the probability that the value of a variable being measured (i.e., an observation) is within a standard deviation of the mean is 0.68. Hence, 68% of the human population will get an IQ between 85 and 115 (see Figure 1).

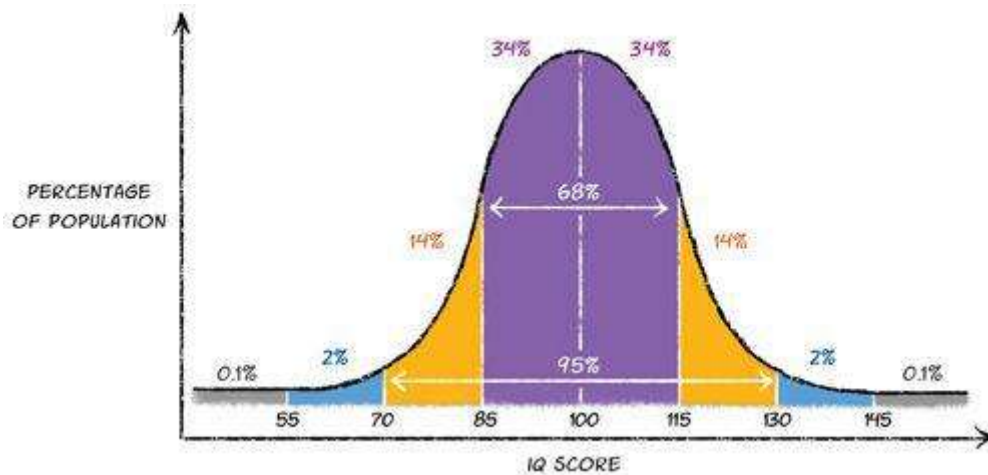


Figure 1. Bell curve for standardized IQ tests reprinted from Ungifted: intelligence redefined by S.B. Kaufman, 2013, Perseus Books Group. Reprinted with permission.

For the EXANI tests, the minimum score is 900 and the maximum is 1300 with a standard deviation of 100 (CENEVAL, 2013b). This implies that 68% of the population will have an IQ or CENEVAL Index (ICNE) between 900 and 1100 (see Figure 2).

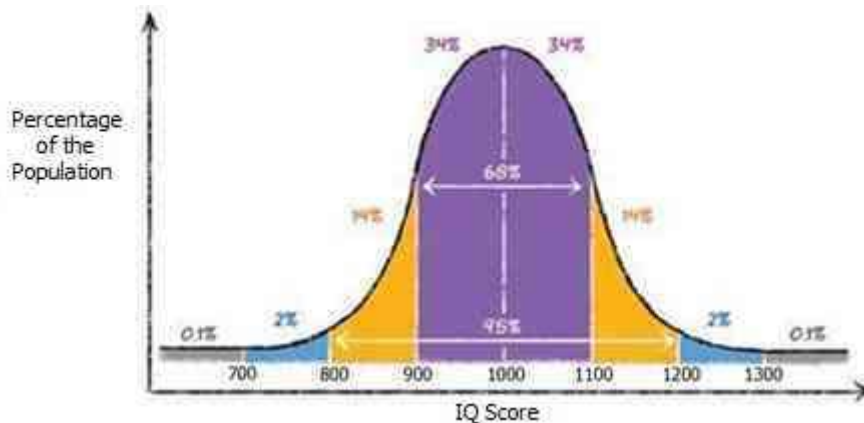


Figure 2. Bell curve for the EXANI II and III. Adapted from Ungifted: intelligence redefined by S.B. Kaufman, 2013, Perseus Books Group. Adapted with permission.

According to Montgomery (2013), in the USA, people are generally considered as gifted or talented, in terms of their information processing skills, when they get a score of 115, or one that is greater than or equal to one standard deviation with respect to the average IQ or theoretical mean of the test. Although CENEVAL does not classify people based on the ICNE obtained in an EXANI test, it does so for the EGEL test, where an ICNE between 1150 and 1300 is considered outstanding (see Figure 3). Consequently, for the case of the EXANI,

it is plausible to consider a person as gifted or outstanding if she or he gets a score greater than or equal to 1100.

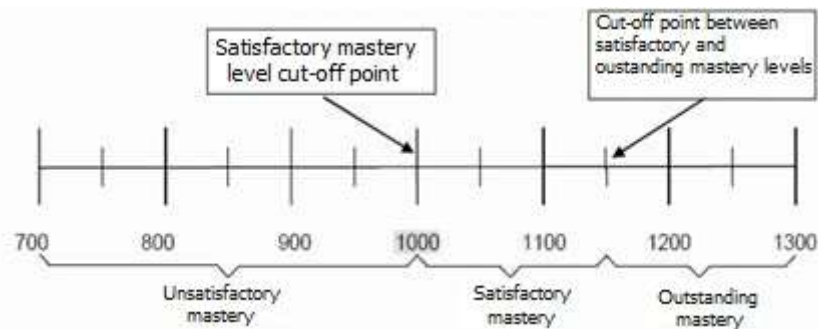


Figure 3. ICNE scale with levels of mastery in the EGEL test reprinted from *Análisis de competencias laborales a partir del Examen General para el Egreso de la Licenciatura (EGEL) y su relación con los cursos en línea* by M. López and K. Flórez. Reprinted with permission.

Finally, just as the American tests, the EXANI have changed over time. For example, according to Martínez, Solís and Osorio (2000), between 1994 and 1998 the EXANI-II consisted of 180 questions distributed in the following 7 areas: Verbal Reasoning (30); Mathematical Reasoning (30); Contemporary World (24); Natural Sciences (24); Social Sciences and Humanities (24); Mathematics (24); Spanish (24). And in 1999, CENEVAL added measurements for 10 specific areas of knowledge (e.g., Calculus, Chemistry, English), giving the freedom to each HEI to choose between the areas of knowledge that deemed pertinent. Consequently, the items for the original 7 areas were reduced to 120, and were assigned as follows: Verbal Reasoning (20); Mathematical Reasoning (20); Contemporary World (16); Natural Sciences (16); Social Sciences and Humanities (16); Mathematics (16); Spanish (16). In its 2013 version (CENEVAL, 2013a), this test contains 100 items divided into the next areas: Logical-Mathematical Reasoning (20), Verbal Reasoning (20), Mathematics (20) Spanish (20), ICT (20).

The EXANI-III test was first used in 1996 and it is the test that has undergone fewer changes. In particular, its structure remains the same since 1996 (CENEVAL, 2007; CENEVAL, 2013b): Logical-Mathematical Reasoning, Verbal Reasoning, Methodology and Research Skills, ICT and English. Only the number of items per area has changed. For the 1996-2007 period the items were distributed as follows: Logical-Mathematical Reasoning (33), Verbal Reasoning (33), Methodology and Research Skills (26) ICT (14), English (14). From 2007 until January 2014, this test's items are divided in the following way (CENEVAL,

2007; CENEVAL, 2011; CENEVAL, 2013b): Logical-Mathematical Reasoning (30), Verbal Reasoning (30), Methodology and Research Skills (30), ICT (20), English (20).

Having established the foundations of standardized admissions tests, in the following two subsections, the analysis of the predictive validity of the EXANI II and III is addressed.

Predictive validity of the EXANI-II

In the study by Martínez et al. (2000), the scores obtained in the EXANI-II, by the applicants accepted in 1996 (121 students), 1997 (127 students), 1998 (148 students) and 1999 (156 students) in the Faculty of Chemistry of the Autonomous University of Mexico State (UAEMEX) were analyzed. In particular, it was found that there is an average correlation of 0.408 between the ICNE obtained by these students, and the GPA obtained in the first semester of their Bachelor degree program. The areas of the test with the highest correlation with first semester GPA were: a) Science (0.280), Mathematics (0.231) and Verbal Reasoning (0.202). However, it was also found that high school GPA alone had an average correlation of 0.568, and if in addition, the areas of Verbal Reasoning (VR), Mathematical Reasoning (MR) and Mathematics (M) were included, the correlation changed to 0.616.

Ponce and García (2003) analyzed the population of accepted applicants who took the EXANI-II in 1999 (i.e., 2757), to enter any of the bachelor degrees offered by the UAEMEX in its Toluca campus, and who did not fail any of their first semester courses. The results were that the ICNE had a correlation of 0.339, while the VR and Natural Sciences (NC) areas had a correlation of 0.495, followed by high school GPA (i.e., 0.421).

The study by Chain, Cruz, Martínez and Jácome (2003) analyzed the EXANI-II results and the academic performance of all the applicants accepted in 1998 (i.e., 6,937) at the University of Veracruz (UV). This study, unlike the previous two, followed the academic performance of these students from their first semester until their last semester. The academic performance, which was the dependent variable, was composed from three basic indicators: the exam passing index (IAO), the promotion rate (IP) and the global GPA (AVG). By applying conditional independence tests and measures of simple correlation, they found that the most important variables associated with the academic performance were VR and Spanish (ESP). Additionally, VR and ESP were the variables with the highest correlation w.r.t

academic performance, with an average of 0.240 and 0.220 respectively. No other variable had a significant impact on the values of the academic performance variable.

While studying the predictive validity of the admission process w.r.t. the academic performance of freshmen enrolled in the Psychology Bachelor degree program ($N= 240$), at the Iberoamerican University, in its Mexico City campus, Cortés and Palomar (2008) found that the ICNE had a correlation of 0.360. However, they also found that the average of the subject specific areas of the EXANI-II (contemporary world, natural sciences, social sciences and humanities, mathematics and Spanish) had a slightly higher correlation: 0.371. Being the social sciences subject area the one which individually had a higher correlation: 0.304. In the multiple regression analysis, the variable that predicted the most variance w.r.t first year GPA was high school GPA ($Beta = 0.352$) followed by ICNE ($Beta = 0.209$).

In 2009, Morales, Barrera and Garnnet (2009) estimated the concurrent and predictive validity of the EXANI-II, of the students accepted in any faculty or school of the UAEMEX in the 2000-2005 period. The basis of the study was composed by a population of 16,756 records of applicants, who were admitted based on the ICNE score. In particular, the existence of a positive and statistically significant association between first year global GPA and the ICNE was corroborated. However, the correlation was relatively low: 0.270. High school GPA showed a greater predictive validity, with a correlation coefficient of 0.400. Also, depending on the Bachelor degree program, the subject specific areas of knowledge of the EXANI-II showed higher correlation coefficients than the ICNE, being the Natural Sciences subject area the one which showed a higher correlation ($r = 0.328$), followed by Mathematics ($r = 0.270$).

The literature on the predictive validity of the EXANI-II is scarce. In 19 years, the Mexican scientific community has only published 5 studies and most of them within the UAEMEX. However, from the number of students tested (24,485), and the time period analyzed (1996-2008), it can be concluded that the suitability of the EXANI-II, as the best resource for deciding the acceptance or rejection, of an applicant, to Bachelor degree programs is questionable. High school GPA has been in 3 of the 5 studies presented the best predictor, with an average correlation of 0.463. This result is consistent with those presented by Atkinson and Geiser (2009) indicating that high-school grades are a better predictor of

success in American undergraduate programs that standardized admission tests such as the SAT (Scholastic Aptitude Test) or the ACT (American College Test).

Predictive validity of the EXANI-III

In a study on the relevance or appropriateness of the EXANI-III as the main tool for the selection of applicants to the Master degree programs at the Interdisciplinary Professional Unit of Engineering and Social and Administrative Sciences (UPIICSA) of the National Polytechnic Institute (IPN), Mazcorro, Aday and Hernández (2007) carried out correlation tests between the ICNE and the grades obtained by the applicants, on 5 exams that form the substantive part of the admissions process (i.e., Accounting, Business Administration, Economics, Linear Programming and Probability). The correlation indices were very low: Accounting (-0.044), Administration (0.095), Economics (-0.018), Linear Programming (0.120) and Probability (0.33). There was also an analysis of predictions (AP) and, as the results of an AP (i.e., the value of the delta variable) can be interpreted as a correlation (Crittenden, Claussen & Kozłowska, 2007), these researchers found that the correlations between the ICNE and the grades on the aforementioned 5 exams, were the following: Accounting (-0.119), Administration (-0.069), Economics (0.017), Linear Programming (0.051) and Probability (0.218).

Solís (2009) carried out a study to investigate the differences between the students who graduate and those who do not obtain their Master degree in Building Construction at the Faculty of Engineering of the Autonomous University of Yucatan (UADY). Regression analyses were conducted, with the dependent variable being the Masters' GPA (PGM) and as independent variables: College GPA (PGL), the GPA obtained in the subjects of the building construction area of their Bachelor degree program (CAP) and the ICNE obtained in the EXANI-III (EXA). The results were significant for the independent variable PGL, with a correlation coefficient of 0.312. With the EXA and PAC variables, the models were not significant (with *alphas* of 0.46 and 0.88 respectively) and *r* values of 0.112 and 0.030. A comparison of means was also performed between the students who earned the degree and those who did not obtained it. No significant differences for the EXA variable were found between both groups.

In a different study, Sevilla, Martín and Guillermo (2009) tried to identify, from the cohorts who graduated from three postgraduate programs (i.e., MINE, MINE and ED) at the

Faculty of Education of the UADY between 2005 to 2008 (236 students), information to develop and admission process model for each of these programs, according to their characteristics, contexts and trends. The study focused on the differences between those who managed to obtain the Master's degree within a year and those who did it after a year. The variables in the study were the following:

X_1 = ICNE obtained in the EXANI-III.

X_2 = Mathematical reasoning score in the EXANI-III.

X_3 = Verbal reasoning score in the EXANI-III.

X_4 = Interview score

X_5 = English score in the EXANI-III.

X_6 = College GPA.

The mean scores of each of these variables was calculated, both for the group that obtained the degree in a timely manner and for the one that could not do so. Subsequently, in order to determine whether differences between the means of both groups were significant, the t test for independent samples was applied. In particular, for the MIE and MINE postgraduates programs, it was observed that there were only significant differences, between the two observed groups, in score obtained in the interview: MIE ($t = 2.121, p < 0.05$), MINE ($t = 3.396, p < 0.05$). While in the ED program the difference was found in the college GPA: $t = 2.362, p < 0.05$.

The small number of studies on the predictive validity of EXANI-III hinders a conclusive position. While for the EXANI-II studies, the period covers accepted students between 1996 and 2008, and even the entire population of students accepted at two universities (UAEMEX and UV), 17 years after the EXANI-III was first introduced as a tool for the admission process in postgraduate programs, only three studies have been done and only at the Masters level. However, the little evidence available indicates that the EXANI-III has no predictive utility, as there are other elements that outperform this test.

Therefore, what can be used as a reliable tool for the selection of applicants to postgraduate programs and in particular Doctoral programs? We have already seen that analyzing the academic performance trajectory, in terms of overall of GPAs, and the use of subject tests, gives better results than the EXANIs. In the following section some of the most

studied personal psychological features, related with the goals of doctoral studies, are addressed.

Psychological factors for success in doctoral studies

Following Lovitts (2005, 2008), obtaining a doctoral degree in any area of knowledge signifies that the recipient has acquired the capacity to make independent contributions to knowledge through original research and scholarship. Successful completion of the dissertation marks the transition from student to independent scholar. In particular, during this transition, graduate students must make a crucial shift from an environment that is tightly bounded and carefully doled out in the form of courses or modules, course outlines and reading lists, lecture topics and assessment tasks, to a highly unstructured context where she or he must be the producer of knowledge. In the words of Azuma (2003), graduate school is not primarily about taking courses, people judge a recently graduated Ph.D. by his or her research, not by his or her class grades. Success in graduate school does not come from completing a set number of course units but rather by successfully completing a unique long-term research program.

Additionally, as Spaulding and Rockinson-Szapkiw (2012) underline, beginning a doctoral degree involves risk. Doctoral students face such a big demand, in terms of effort and dedication that their personal and social lives are strongly affected; insomuch that it later becomes a reason for dropping out. For example, several studies (Ali & Kohun, 2006; Gardner, 2009; Lovitts, 2005) indicate that in the USA, at least 40% of students who enroll in a doctoral program drop out before obtaining candidacy and among those who obtain it, about 25% end up giving up. A similar situation occurs in Australia (Jiranek, 2010) where around 40% of doctoral candidates, depending on the area of knowledge, abandon their doctoral studies.

The literature records several theoretical models (Jiranek, 2010; Lovitt, 2005, Smith et al, 2006; Spaulding & Rockinson-Szapkiw, 2012; Wao & Onwuegbuzie, 2011) of factors involved in transforming doctoral students into producers of knowledge, rather than consumers of knowledge. Although there are differences between these models, the most significant coincidence is that they all show that obtaining a doctoral degree is a longitudinal process in which personal factors determine the effectiveness of institutional strategies (see Figures 4 and 5).



**Figure 1. Jiranek's (2010) model:
Factors affecting success in doctoral studies.**



**Figure 2. Lovitts' (2005) model:
Factors affecting success in doctoral studies.**

Some studies (Ahern & Manathunga, 2004; Kearns, Gardiner & Marshall, 2008) point out that candidates who drop out present self-sabotaging or self-handicapping behaviors. Its performance is marked by attitudes of *procrastination*, *perfectionism* and *overcommitment* to other activities different from those of their doctoral program. Other studies, such as Ali and Kohun (2006) suggest that *emotions* and *feelings of isolation* are among the factors that most affect attrition in doctoral studies. According to this study, these feelings stem from the lack of (or insufficient) communication between students and students and faculty.

In particular, those students who manage to avoid these behaviors and complete their Doctoral dissertations on schedule, are regularly more *hardy* or *persistent* and more *focused* on their task (Kearns, Gardiner & Marshall, 2008). Their desire to reach the summit of academic achievement (Brailsford, 2010) is accompanied by a disposition to meet and overcome challenges and sacrifices associated with doctoral studies (Spaulding & Rockinson-

Szapkiw, 2012). That is, they have *intrinsic reasons* (e.g., interest in their research topic) and are *engaged* more strongly with the success of their studies (Ahern & Manathunga, 2004).

In the next section, some specific psychological factors (i.e., a subset of personal factors) that the literature records as having a significant importance, in the path of successfully obtaining a doctoral degree, are analyzed. They are expounded, seeking to complement the traditional tools for admission to higher education programs (i.e., EXANI).

Grit

This factor is considered by Duckworth, Peterson, Matthews and Kelly (2007) as one of the personal qualities that is shared by the most prominent leaders in every field. Grit is a subcomponent of one of the big five personality factors called *conscientiousness* (Almlund, Duckworth, Heckman, & Kautz, 2011) and it is defined as perseverance and passion for long-term goals (Duckworth et al., 2007). In particular, grit entails working strenuously toward challenges, maintaining effort and interest over many years despite failure, adversity, and plateaus in progress. The gritty individual approaches achievement as a marathon; his or her advantage is *stamina*. Whereas disappointment or boredom signals to others that it is time to change the trajectory and cut losses, the individual that demonstrates grit stays the course.

In this sense, grit is distinct from dependability aspects of conscientiousness, including self-control, in its specification of consistent goals and interests. For instance, an individual with high self-control but moderate grit may, for example, effectively control his or her temper, stick to his or her diet, and resist the urge to surf the Internet at work—yet switch careers annually. Several studies about grit have been carried out between 2007 and 2014. These studies are described next.

Duckworth et al. (2007) analyzed the role of grit in success outcomes, including educational attainment among 2 samples of adults aged 25 and older ($N=1,545$ and $N=690$), grade point average among Ivy League undergraduates ($N=138$), retention in 2 classes of United States Military Academy, West Point, cadets ($N =1,218$ and $N =1,308$), and ranking in the National Spelling Bee ($N=175$). In the first two studies, it was found that grittier individuals had attained higher levels of education, and made fewer career changes than less gritty individuals of the same age. In Study 3, undergraduates who scored higher in grit also earned

higher GPAs than their peers ($r = 0.250$, $p < .01$), despite having lower SAT (Scholastic Aptitude Test) scores.

In a subsequent report of the results of five studies, Duckworth and Quinn (2009) found out that grit was inversely related to the number of lifetime career changes individuals had made, even when controlling for age and conscientiousness. Similarly, they found a significant correlation ($r = 0.298$) between the final GPA during two consecutive years (i.e., 2006 and 2007) of high-achieving middle and high school students. In a more recent study of 140 African American male undergraduate students enrolled in a predominantly white American public university, Strayhorn (2014) found that grit explained 24 % of the variance in black males' college grades.

All together, the evidence presented here gives elements to affirm that grit is a variable of interest for the prediction of academic success through different educational levels.

Self-regulation

A person's capacity to voluntarily control her or his attentional, emotional, and behavioral impulses, in the service of personally valued goals and standards, is usually identified with the names of self-regulation, self-control or self-discipline (Duckworth & Carlson, 2013; Gong, Rai, Beck, & Heffernan, 2009; Muammar, 2011; Oaten & Cheng, 2006). Although there are differences between these terms, in particular related to levels of practical consciousness, in general, they refer to a psychological condition from which the person tries to control the resources, attitude and the path that allows her or him to achieve a particular set of objectives. Self-regulation is a kind of personal willingness to pursue and achieve the desired goal, and which conditions all efforts, strategies and moods associated with such goal (e.g., Pasternak, 2013).

According to (Duckworth & Seligman, 2006), examples of self-discipline include deliberately modulating one's anger rather than having a temper tantrum, reading test instructions before proceeding to the questions, paying attention to a teacher rather than daydreaming, saving money so that it can accumulate interest in the bank, choosing homework over watching TV, and persisting on long-term assignments despite boredom and frustration.

However, de la Fuente and Justicia (2007) propose that when speaking about regulatory processes in academic environments, it is necessary to broaden the scope of the learning and teaching concepts. From their perspective, the complexity of these concepts requires recognition of the educational process with more openness, accepting that there are constraints derived from the learner, the teaching and the context in which this occurs. Self-regulation is a product directly influenced by the learner's personal determinants, as well as by the actions of teaching, the task and the environment in which it takes place. A student is not insensitive to the teaching proposal that she or he receives, to the nature of the content or the environment in which the task is presented. Thus, conceiving self-regulation as a product only of the individual severely limits this concept, because then, its occurrence depends of only one factor: the individual.

In two studies with eight grade students ($N=140$ and $N=164$) Duckworth and Seligman (2005) report that highly self-disciplined adolescents outperformed their more impulsive peers on every academic-performance variable, including report-card grades, standardized achievement-test scores, admission to a competitive high school, and attendance. In particular, in study 2, the correlation between self-discipline and final GPA ($r=0.670$) was twice the size of the correlation between IQ and their final GPA ($r=0.320$). When IQ and self-discipline were entered simultaneously in a multiple regression analysis, self-discipline accounted for more than twice as much variance in final GPA ($\beta=0.650$, $p < .001$) as IQ did ($\beta =0.250$, $p < .001$). Moreover, self-regulation was also a predictor of the number of hours spent doing homework ($r=0.350$, $p<0.001$).

In their article on *gender* and *self-control*, Duckworth and Seligman (2009) present the results of two studies. The first study analyzes the data of 140 eighth-grade students from a socioeconomically and ethnically diverse magnet public school, in a city in the northeast of the USA. In particular, when comparing composite scores of self-discipline, girls were more self-disciplined than boys $t(138)=4.12$, $p=0.001$, $d=0.71$. Additionally, composite self-discipline correlated significantly with overall GPA ($r= 0.570$, $p<0 .001$) and less robustly with achievement test scores ($r=0.290$, $p=0.001$). Furthermore, it was found that self-discipline predicted overall GPA when controlling for gender ($r=0.500$, part $r=0.470$, $p<0.001$).

In a subsequent study with fifth and eighth grade students, Duckworth, Tsukayama and May (2010) report that self-control plays a causal role in academic achievement and that changes in self-control during middle school predicted changes in GPA, $\beta_{30} = 1.81$, $t(610) = 4.47$, $p < 0.001$.

Thus, self-discipline seems to be an important factor for successful academic performance.

Achievement goals

Although *achievement goals* is a construct that is discussed from different but similar theoretical constructions (de la Fuente, 2004; Was, 2006), the working definition adopted in this article is the one provided by Hulleman, Shragger, Bodmann and Harackiewicz (2010), which states that an achievement goal is a *future-focused cognitive representation that guides behavior to a competence-related end state that the individual is committed to either approach or avoid*.

According to Senko, Hulleman and Harackiewicz (2011) there are 4 types of achievement goals: 1) Performance-approach goals (i.e., striving to outperform others or appear talented); b) Performance-avoidance goals (i.e., striving to avoid doing worse than others or appearing less talented); c) Mastery goals were divided into mastery-approach (i.e., striving to learn or improve skills) and d) Mastery-avoidance goals (i.e., striving to avoid learning failures or skill decline). In this subsection only goals “a” and “c” are addressed.

Hulleman et al. (2010) reviewed 243 correlational studies of self-reported achievement goals, which used different types of scales, comprising a total of 91,087 participants from different educational levels ranging from elementary school to college. In particular, performance-approach goal scales coded as having a majority of performance-approach referenced items had a positive correlation with performance outcomes (i.e., academic achievement): $r^{\wedge} = 0.14$. Whereas, when all of the items were coded as mastery-approach, the correlation was of: $r^{\wedge} = 0.05$, $t(64) = 2.64$, $p < .05$. Nevertheless, this kind of goal showed a higher correlation with interest: $r^{\wedge} = 0.44$, $t(51) = 15.98$, $p < .01$. A subsequent review of 24 studies by Senko, Hulleman and Harackiewicz (2011) validates these results.

In particular, the cumulative evidence shows that performance-approach goals are often associated with high grades irrespective of underlying ability of confidence and learning strategy of the student (i.e., Deep learning and surface learning). However, in contexts that required a deep understanding of the course material and synthesis of course concepts, initial results are mixed between the mastery and performance approaches, which indicates that more studies are needed, in order to prove which approach correlates the most with deep learning strategies.

There are also studies which have focused on the link between achievement goals and activity and outcome *emotions*. Examples of positive and negative activity emotions are enjoyment, boredom, and anger; examples of positive and negative outcome emotions are hope, pride, anxiety, hopelessness, and shame. For example, in a study with 218 undergraduates (147 female and 71 male) in a psychology course (social–personality psychology) who took part in the study in return for extra course credit (age: $M = 19.43$, $SD = 1.76$ years), Pekrun, Elliot and Maier (2009) found that hope and pride were the emotions that best predicted exam performance (i.e., $F(1, 213) = 14.42$, $p < .001$ ($\beta = .27$) and $F(1, 213) = 17.34$, $p < .001$ ($\beta = .29$) respectively). While performance-approach goals was the strongest predictor for exam grades: $F(1, 214) = 14.15$, $p < .001$ ($\beta = .38$). Although the relationship between mastery goals and performance was not significant (i.e., $F(1, 214) = 3.02$, $p = .08$ ($\beta = .11$)), they were a negative predictor of boredom (i.e., $F(1, 214) = 50.54$, $p < .001$ ($\beta = -.43$). This is important because boredom was a nearly significant negative predictor of performance: $F(1, 213) = 3.71$, $p = .055$ ($\beta = -.14$).

Other studies have paid attention to how students' achievement goals interact with different forms of instruction to promote *transfer*, defined as preparation for future learning. In this sense, Belenky and Nokes-Malach (2012) carried out a study in which 104 undergraduates (M age = 18.5 years old, $SD = 0.8$ years, range = 18–22; 42% male, 45% female, 13% did not report their gender on the demographics sheet) from an Introduction to Psychology course at the University of Pittsburgh participated. These researchers found that mastery-approach goals may serve as a mechanism of transfer that facilitates constructive cognitive processes and helps connect later learning episodes with relevant earlier learning ($\beta = 0.37$). Additionally, they underline that although mastery-approach goals do not have a significant relationship with measures of achievement in classroom settings (i.e., exam grades) these results may have to do with the measures themselves. Consequently, mastery-approach orientations would be

associated with performance on more conceptual, open-ended, and application-based questions, whereas performance approach orientations would be associated with performance on more factual, procedural, and recall-based questions.

The results previously presented, as well as the relationship between mastery goals and the deep understanding of the course material and synthesis of course concepts, point out that this construct is of particular interest, to educational opportunities that require these skills.

Creativity

From all the constructs analyzed in this article, the one called creativity is perhaps the most elusive. For example, Plucker, Beghetto and Dow (2004) found 34 different definitions for this construct, each addressing a different nuance. For this reason it is easy to find different ways to evaluate the creative potential of individuals (Kaufman, Plucker & Russell, 2012). In this article the definition of Eco (2007, p.78) is taken, as it is, in our opinion, sufficiently general and rigorous to include the above definitions as well as the new conceptions of creativity identified by Kaufman et al. (2009).

For Eco (2007), creativity is an activity that produces something unprecedented that a community is prepared to recognize, accept, make their own and rework, in the long run, and that becomes a collective patrimony, available to all, and not only for personal enjoyment. Moreover, for creativity to be worthy of this name, it must be imbued with critical activity. Hence, the idea which emerged during a brainstorming session and was enthusiastically accepted because it was not possible to think of anything better, cannot be considered creative. For an idea to be creative it has to be analyzed and, at least in the case of scientific creativity, it has to be susceptible to falsifiability or refutability. Consequently, creativity is developed by innovation, i.e., by inventing new ideas, but also by criticizing knowledge or past practices, and above all, by analyzing our own discourse.

Because creativity includes innovative actions, it is often confused with IQ. To analyze the relationship between IQ and creative potential, the latter represented by divergent thinking (DT), i.e., the ability to generate many answers to open and multifaceted problems (Gibson, Folley & Park, 2009), Kim (2005) reviewed 21 studies with a total of 45,880 participants. What she found was that the average correlation between IQ and divergent

thinking was small: $r = .174$; 95% $IC = .165 - .183$. When the IQ scores were divided into the four levels the correlations were the following: $CI < 100$ [$r = .260$]; $100 < CI > 120$ [$r = .140$]; $120 < IQ > 135$ [$r = .259$]; $IQ > 135$ [$r = -.215$]. With no statistically significant differences among the levels which indicates that even students with low IQ scores can be creative.

Later, Kim (2008) conducted two analyses. The first, analyzed 17 studies (with 5,544 participants) that established the correlation coefficients between IQ and creative achievement (CA), which can be defined as the sum of creative products generated by an individual in the course of his or her lifetime (Carson, Peterson & Higgins, 2005). The second covered 27 studies (with 47,197 participants) that established the correlation coefficients between DT test scores and CA. After weighting by sample size, the mean value of r between IQ and CA was .167 (95% $IC = 0.141 - 0.193$), whereas the mean value of r between DT test scores and CA was .216 (95% $IC = 0.207 - 0.225$).

Furthermore, the mean values of r between DT test scores and CA in art, writing, science and social skills were the following: .232, .187, .166 and .171 respectively. While the mean values of r between IQ and CA, for the same areas, were: .056, .172, .061 and .119 respectively. The creativity subscales of strength and elaboration (Kim, 2006), were the ones who showed a higher correlation with CA: .300 and .322 respectively. Interestingly, the mean value of r between DT and CA in science (.166) was almost the same as the mean value of r between IQ and CA in science (.167).

In summary, the values offered by the assessment of the relationship between creativity and CA appear to be indicators that the former plays an important role in being successful across different areas of expertise.

Dicussion

Higher education, particularly at the postgraduate level, is looking to have increasing levels of efficiency in terms of completion or graduation rates and research productivity. In order to achieve such a goal, the admission processes to postgraduate programs have been sophisticated, through the use of standardized tests and other types of assessments which aim to predict the success of the applicants in these programs. In this route, many psychological and subject specific tests have been developed, but not all of them have been as efficient as

expected. In this paper, these problems were analyzed and evidence was shown that the application of standardized tests does not offer the desired certainty for achieving the purposes described before. Within the Mexican context, it is shown that it is possible to do without the EXANI-II and use high school GPA and subject tests (e.g., Natural Sciences and Mathematics), as tools for the selection and prediction of academic success in Bachelor degree programs (e.g., Morales, Barrera & Garnnet, 2009). However, studies that cover the variety of high school types in Mexico (e.g., technological and preparatory) and include more cohorts and universities (e.g., public vs. private) are required. For these cases questions such as the following remain pending: What type of high school best predicts academic success? Is there a relationship between the type of high school and the results obtained on the EXANI-II?

The predictive utility of the EXANI-III for graduate studies was not encouraging either. Although the studies that document this fact are few, the mean value of r between the ICNE and subject tests scores (e.g., Mazcorro, Aday & Hernández, 2007) was low in the analysis of prediction (e.g., from .059 to .020). Additionally, the EXANI-III did not have an acceptable correlation ($r = .030$) with the Master degree program GPA in the study of Solis (2009). Moreover, it was not a predictor element, in the same study, of on schedule degree completion.

The data indicates that caution should be exercised when using standardized tests as a resource for the prediction of academic success in postgraduate programs. Many more studies are needed to reach more solid conclusions. In particular, because the EXANI-III is widely used by Mexican HEI to justify the acceptance or rejection of applicants to postgraduate programs and, because CONACYT establishes this test as a prerequisite for programs that are in its PNP.

Besides the predictive inaccuracy of standardized tests, the reviewed literature provides evidence that the selection of applicants can be more efficient if it incorporates the assessment of other aspects, different from IQ, including the academic trajectory of applicants. As for the psychological constructs discussed in this paper, it was shown that by definition, people with a high level of grit, self-discipline and positive achievement goals, avoid self-sabotaging behaviors and, through creativity, they prevent isolating emotions or feelings that ultimately reinforce the impediments to achieving academic goals. Several other elements can

be added to this mix. For instance, Sternberg et al. (2012) argue that student selection to HEI programs must also take into account ethical aspects and propose to measure the level of wisdom of the applicant through self-reports.

Nevertheless, it is necessary to underline that none of the analyzed constructs have been tested in postgraduate admission processes. Therefore, at least for the case of Mexico, it is necessary to conduct studies that take into account these elements and observe the results, just as it is being done in the USA with other constructs (Atkinson & Geiser, 2009; Megginson, 2009; Sternberg et al. 2012).

Finally, in addition to the aforementioned limitations, this article did not discuss: a) the administrative and socio-political implications (e.g., Márquez, 2012) that mediate the use of standardized tests in Mexico and b) the internal systems by which the Mexicans HEI implement reliable assessments. The analysis and discussion of these and other issues is too broad and beyond the scope of this publication. Hence, it constitutes part of the future work to be done.

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