KEY COMPETENCES AND ACADEMIC ACHIEVEMENT IN MEXICAN HIGH SCHOOL TECHNOLOGICAL EDUCATION

by

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ABSTRACT

KEY COMPETENCES AND ACADEMIC ACHIEVEMENT

IN MEXICAN TECHNOLOGICAL HIGH

SCHOOL EDUCATION.

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The general purpose of the study was to determine the relation between key competences and academic achievement in technological high school students in the state of Nuevo Leon.

This dissertation was based in the contributions and investigations made from the approach of one of the contemporary theories of human capital. Human capital is the result of three fundamental aspects, recognized in the contemporary literature as key competences. These key competences are language, formal reasoning and mathematical skills.

This study was a secondary data analysis. The dependant variable was academic achievement, represented by the GPA. The independent variables were the key competences, represented by verbal abilities, the capacity for mathematics

learning and formal reasoning, measured trough an standardized test delivered by COSNET and applied to all the appliers for enrollment in the technological education system in the state of Nuevo Leon (DGETI).

The sample were first year students enrolled in DGETI schools in the state of Nuevo Leon that applied for the enrollment evaluation for high school in January 2006. The final sample includes a number of 1610 students.

Several descriptive and inferential procedures were performed for the data processing. Test of univariate and multivariate normality were conducted. A confirmatory analysis of first order validated the model factors for the exogenous sub-scales. A confirmatory analysis from the factorial measure model of key competences and an evaluation of the structural modeling trough the structural equation modeling (SEM) were conducted.

The results of this research study showed that only two of the factors, verbal ability and mathematics ability, were validated in the measurement model. These key competences explain academic achievement. Verbal ability is the key competence that best explained academic achievement.

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CHAPTER 1

INTRODUCTION

The High School Education Subsystem (SEMS, 2004), specifically the General Administration of Industrial and Technological Education (DGETI, 2007), develops nowadays programs oriented to promote the improvement of its educational quality's services through the operation of a wide educational reform. The educational reform initiated in the 2004 and consist of a curricular reform (EBT, 2004) and a didactic reform (MEMST, 2004). This mentioned reform started in 2004 and it consists of a curricular reform (EBT, 2004) and a didactical reform (MEMST, 2004). The axis of this reform is based in a pedagogical view which departs from Bleger (1983) to Delors (1994). It has, as an important antecedent, the classic European authors of the constructivism, such as Piaget (Munari, 1999) and Vigotsky (2004), as well as those of the North American cognitivism, such as Bruner (1972) and Ausbel (1968). Their local promoters, who expose in classes and conferences; and write papers for journals and books are: Toledo Hermosillo (1998), Sosa Peinado (2006), Ramírez Hernández (2006), Zabala (2000) and Santos Rego (2000).

In the beginning of the new six-year presidential period, a new educational reform is implemented. This is called the Integral Reform (Szequely, 2007b). This reform considers compensatory educational policies, such as a scholarship

program; an actualized regulation; an integral evaluation system; a new authority's election system and a modified accountability system for the final user of the educational services, among others. Each one of this educational policys are available for consulting trough the web page of SEMS in Nuevo Leon (Szequely, 2007). This integral reform represents the perspective of the new administration of the Public Educational Bureau (SEP) which emphasizes the factors directly related with the social development and prioritizes the compensatory policies. Without denying the basis of the didactic (MEMST, 2004) and curricular (EBT, 2004) reforms, we are now intending to complement it. That is why it is called an Integral Reform (Szequely, 2007).

To underline the characterization of both phases of the educational reform is relevant because the official documents of the The High School Education Subsystem considers that in the technological Mexican high school, the constructivism is the fundament of an educational policy in their didactic an curricular aspects. Such base is developed in two documents called Technological High School Education Model (MEMST, 2004) and Technological High school Structure (EBT, 2004). The first one explains the educational philosophy as well as the didactic and pedagogical fundaments of the reform. More specifically, it describes the teaching model based in the learning. The second document defines the structure of the curriculum and describes the courses in each module, as well as the redefinitions of the new courses and hours in the new model.

The same First Entrance High School Evaluation of COSNET has constructivist fundaments, and, therefore, to study the academic achievement from the key competences point of view supposes to consider the cognitive factors in the explanation of the academic achievement.

1.1 Educational Coverage and Final School Efficiency

The implementation of the Educational Reform of DGETI responded to different factors. Among them, it is underlined the results showed in the school registration indicators, called educational coverage, (53.5%), as well as final efficiency indicators (58.9%) for high school education, which were published by the Public Education Bureau (SEP, 2004). These indicators are importatnt parameters to estimate the opportunities of improving the educational system and justify a critical appreciation the educational system condition in the period before the reform.

1.2 The PISA Report

Other concern that motivated the establishment of the Educational Reform of DGETI (General Department of Technological Education for Industry and Services) was the result of the academic achievement evaluations received in 2003 in the PISA report (Programme for Indicators of Student Achievement), were Mexican students of this level (fifteen to sixteen age) had an achievement below to the mean of the OECD countries (PISA, 2003).

International evaluations of educational quality, such as those of PISA (2003), set the topic of the transverse competences in the center of the national educational debate. This is a study executed each three years in a group of

industrial countries promoted through the governments that participate in the OECD. The view of the study focuses on the evaluation of the aptitudes related on the capacity of the students for applicating knowledge and abilities to solve problems in specific key courses. The specific purpose of the study was to analize the aptitudes for mathematics, sciences and the resolution of problems and reading. To explain the factors that compromise the quality of educational service in high school is not only a matter for specialist's analysis. It's an important topic for teachers, educational administrators and, in general, for officials involved in the implementation of educational policies. The main reason is that these last sector participate directly in the implementation of such educational policies and, for that reason, any improve process must consider the relevant role of this sector. The PISA results questioned seriously the conceptual criteria that fundamented the educational policies that were implemented before the inclusion of the reform in the high school education (PISA, 2005). Based on these arguments, it must be outlined that the referred educational indicators and the PISA results were relevant data in the moment in which the educational reform of 2004 was implemented. Both cases described a comparative disadvantage of the high school educational service.

1.3. Establishment of the Research Problem

Academic achievement and GPA are research subjects that have been studied from different conceptual and methodological approaches. The PISA evaluation is a test of knowledge and abilities. Its results permit to compare the academic achievement of students from different nationalities. In this sense, the

PISA report is an evaluation of the academic achievement. Its conceptual base rests in a cognitive interpretation of the human capital, denominated as key competences (Salganik, Rychen, Moser and Konstant , 1999).

In the specialized literature, prior to the PISA report (2005), the contributions of Agodini (1997) are outlined. This author studied the curricular changes, called the new basics in the USA educational reform, as an important factor to explain the academic chievement. This study was based in the human capital theory. In other study, carried out by Caudill and Gropper (1991), an evaluation instrument based in the classic theory of human capital was used to evaluate the students achievements.

The differences between the scores of the students and their characteristics in terms of human capital did not result relevant for the study. Moore and Keith (1992) reported the elaboration of a human capital model designed to evaluate student's achievement. They define success considering the participation of students in commitments and activities related to their professional aspirations. In all three cases, there is an instrument designed on the basis of a common theoretical approach: human capital. A hypotetical relation is established between the conception that supports the evaluation instrument and specific achievements evaluated trough the student's performance. This kind of study is not new. The studies that link the entrance evaluations for junior high school, high school and college education to the predictive capacity of school grades as indicators of academical achievement are discussed in the north american literature since the 30's (Linn, 1966).

Grade Point Average (GPA) is generally measured trough a system of scholar evaluation that translates the student's accomplishments into a quantitative gradation. This allows comparing academical achievement among students. Consequently, GPA has been standardized trough school grades. Despite the contributions above mentioned, GPA is a topic little attended in the specialized literature, particularly in the specialized Mexican literature.

There are two definitions of academical achievement used in this study. One of them says that academical achievement is the grade's mean that the students obtain trough their different courses. This is the traditional definition: academical achievement equals GPA. The second definition describes academical achievement as a linear combination of grades assigned from different courses including some compensation factor, named coeficient. The mathematical calculation isnt an average, as it includes a coeficient thet varies for different author's. This definition of academical achievement is the so called factorial adjusted GPA. When this research study mentions academical achievement, we are refering to this other definition.

When a generation is promoted, in the academic sense of the term, expectations from a generation of students, a group of professors and administrative personnel, and the rest of community are fulfilled. Nevertheless, the educational wellbeing is a concept wider than academic achievement, although for the case, until this moment, they could be considered as synonymous.

Among the international standards for educational meassures and comparison between different countries, the one from OECD is pointed out. This is based on a theoretical supported in the concept of key competences (DESECO, 2005; Rychen, Salganik and McLauglin, 2001). This model is used currently by SEP for the new measures of educational indicators trough the ENLACE test. This indicators are composed in to categories : mathematical abilities and language skills and they are considered academical achievement factors (Rychen and Salganik, 2003).

This study intends to contribute to the explanation of academical achievement from an specific theoretical approach. It proposes to evaluate the influence of certain cognitive skills in the students trough the results ofn their academical achievement, the so called key competences (OECD, 2005; OECD 2006). This key competences are: language skills, mathematical abilities and formal reasoning skills (DESECO, 2005). The conceptual framework that supports this proposal is partially represented by the classical theory of human capital, founded by Schultz (1961) and more widely by the contemporary versions promoted by OECD (DESECO, 2005).

In the classic approach, Schultz (1961) defined human capital as knowledge and abilities. In the OECD's version human capital is treated as the intersection between knowledge, abilities, competences and other attributes integrated individually and that are relevant for the social, personal and economic well-being (OECD, 2006). Consecuently, the main research question for this dissertation is: are the key competences relevant factors in the explanation of

academical achievement?. This question establishes the research problem for this study. In order to respond the research question, the next objectives were formulated.

1.4 General Objetive

The objective for this work is to determine the relations between key competences and academic achievement.

1.4.1. Specific Objectives

This research considers indicators of academic achievement from students in high school centers called Technological Study Centers for Industry and Services (CETIS) and Technological High School Centers for Industry and Services (CBTIS) which belong to the General Department of Technological Education for Industry and Services (DGETI) in Nuevo Leon. This study collects academic data from young students who assist to this particular educational subsystem. This data comes from the 2005 class, and are collected from the results' database of the COSNET evaluation celebrated in august 2005. In addition, a second group of these data will be collected from the official database of the final evaluation of the semester August 2005- January 2006.

The specific objectives are considered next:

- To establish the differences in the levels of academic achievement of technological high school students in the DGETI of Nuevo Leon.
- To establish a degree of development of the key competences of high technological school students in the DGETI of Nuevo Leon.

- To determine if this key competence have an influence in the academic achievement of the mentioned students.
- To establish a degree of influence for each one of this key competences in high school students in the DGETI of Nuevo Leon.

1.5 Justification of the Study

The development of this study is significative from several different approaches. From the social approach, this investigation is important because the comprehension of the relations between academical achievement and key competences contribute with elements that support the optimization of the budgets for high school education, which are currently limited. Such explanations provide objective procedures that condition the academical results of our students.

This study is theoretically relevant because it intends to contribute in the ground of the analysis and design of educational policies as they generate important suggestions in this field, particularly in the critic to the design of national and international evaluations, such as the PISA, ENLACE and COSNET tests.

The components of key competences are a subject of international debate that reverberate in the evaluation of different aspects of the student's performance and, consecuently, in the redesign of different policies in our educational system. Given the results of the international comparisons of the PISA evaluation, a different approach of key competences will reverberate in the results of the evaluation and the institutional proposals and suggestions in which

the educational projects of high school will be sustained. The treatment of this conceptual lacks has a capital importance in the process of the integral reform for high school education.

This study has methodological relevance from different angles. It offers a local evaluation of a problem that is currently studied nationwide as it contributes with a different point of view. It analyses the databases of the official tests from an independent perspective and it introduces an hypotesis test methodology whose results have not yet been appreciated in the local scientific community.

CHAPTER 2

LITERATURE REVIEW

The purpose of this section is to analyze and discuss the theory and investigations used as a conceptual framework in the explanation of academic achievement. First of all, the concept of “academic achievement” and the specialized literature for this subject will be analyzed. Further, we analyze the theme of human productivity from the contributions of the theories of intangible capital. Finally, the human capital theory that fundament this research study will be approached.

The human productivity theories, also called Intangible capital theories, are represented by the concepts of social capital (Coleman, 1988), and cultural capital (Bourdieu and Passeron, 1995). Both are referred in this section as important conceptual antecedents, but not as part of the theoretical framework. Further, we introduce the explanation of academic achievement from the perspective of human capital theories. Then, in a very particular way, the theoretical models that are relevant for our research problem will be discussed. One of them is the human capital theoretical model proposed by Schultz (1961) and Becker (1964).

The other model is represented by Salganik and Rychen (2003 b), where the concept of fundamental competences for life is analyzed.

2.1 Conceptual Framework: Academic Achievement

The concept of academical achievement have been elaborated in different moments by the specialized literature (Claudill and Gropper, 1991; Moore and Keith, 1992; Etcheverry, 1996 and Agodini, 1997). As we described above, the performance of a student is measured trough a system of quantitative evaluation. Academical achievement, in the most traditional versions, is registered trough an average of school grades. The operationalization of the concept of academical achievement has been represented by the GPA. Although in the english language the denomination of the concept of academical achievement is practically generalized; in the spanish language, different expressions such as academical success or school success, have been used indistinctively (Arias and Chávez, 2002).

The clasic study in this matter was elaborated by Linn (1996). It has the structire of a metha-analysis and it deals with the review of a wide group of studies developed between 1927 and 1960. In such studies, the relation between GPA and academical performance is the center of debate. The authors of these studies were interested in the need to standardize the tests and clarifying the differences in the performances from the differences between schools. The curriculum of each one of them and the particular standards to establish the grades. The differences described by Linn (1966) tilted to include more predictors of academical achievement.

Jhonson (1997) affirmed more recently that GPA is the most widely used way to summarize the academical achievement of college students. Due to its

wide acceptance, it is pertinent to keep the GPA as an academical achievement indicator. This perspective has been defended in the mexican specialized literature by Arias & Chavez (2002) who have received critics for using the GPA as an indicator of academic achievement. Arias & Chávez (2002) say that to compare the grade percentage average (GPA) with the academic achievement (relating specifically about scholar success) has been a very criticized attitude, but nevertheless "…the detractors have not proposed a better indicator. Besides, the average measure is the most common aspect and the most used by authorities, students, scholarship donators and employers" (p.209) [i]

2.1.1 Critiques to GPA

Beside the expressed acceptance for the GPA, there is a growing manifestation of criticism for the use of grading average as a mean to characterize the academic achievement in the college level and recently in the high school. An important group of studies proposed, some years ago, to analyze other alternatives instead of the GPA as measure of academic achievement, such as those named adjusted measures (Lei, Bassiri y Schulz, 2001; Greenwald & Gillmore, 1997; Johnson, 1997; Bejar & Blew, 1981; Caulkins, Larkey & Wei, 1996; Ziomek, 1995; Linn, 1966; Stricker, 1994; Young, 1990a; Young; 1990b; Samejina, 1969).

Among the arguments that prevail, those of Jhonson (1997) can be outlined, who holds the idea that the scheme of combining the simple GPA harm the students that are registered in a more rigorous academic program and,

furthermore, it affects the process in which the students decide what courses must select in each semester.

2.1.1.1 The Definitions of GPA and the Adjusted GPA

In the definition of Wei, Bassiri and Shulz (2001) the GPA is a linear combination of grades assigned from different courses. In its simpler way, it is an average of this group of courses. In his opinion, the GPA is widely known as an imperfect measure of the academic achievement of the students. The main critique that they formulate is centered in the problems of predictive validity between GPA and the evaluation's tests of first entrance applied to students of the high education level in the universities. They argue that adjusting the courses' grades for the different practices or grade styles of the teachers improve the predictive validity of the GPA. Further, they add that, with the adjusted averages, there is more consistency with the new grades achieved during their permanence in the university. The policies about who and how the courses are chosen and about the tolerance in the variation of the ways that the teacher assigns grades are two important factors in the holding of the predictive validity of GPA. For that reason, it is necessary to adjust these two policies or to establish compensatory factors included inside the same definition of the GPA. By this means, they talk about the need of an adjusted GPA or AGPA.

In the perspective of the Mexican technological high school education, the first problem is absent. In contrast to the department modalities of many North American universities, in the technological high school the students are assigned to a course depending from the administrative needs of the institution, and not

depending from the perception of each student about the program or the teacher in charge of that academic course.

There are other problems linked to the use of the grade average as a measure of academic achievement. These problems are produced by the existence of academics institutions that decide the assignation of scholarships or employment offerings supporting their decisions in the in the grade average of the candidates (Lei, Bassini & Schulz, 2001). This argument establishes that different professors have different criteria according to their own and particular perception of the academic achievement of their students. The statement that claims that GPA is not strictly comparable among students and particularly when they come from different schools or careers is confirmed.

The problem of the academic inflation (Young, 1990a; Johnson, 1997; Bejar & Blew, 1981) is another factor to take in count. This problem is defined as an attitude in which the teachers low their standards in order to improve the students' perception about their courses. This way, students would choose the courses taught by teacher recognized as indulgent at the hour to assign their grades, or would tend to choose careers or specialties in which the teachers easily assign high grades. Although this phenomenon is typically of a university nature, it is not exclusive from the university level. Ziomek (1995), has documented similar phenomenon in the high school level.

Lei, Bassini & Schulz (2001), describe the alternative of impose an standard of common grade to all teachers, establishing an AGPA. In other words an adjusted GPA for the differential difficulties of the courses. This would be a

compensatory value for each course that permits to equilibrate the differences in the inflation factor. They suggest to complement the GPA with the assistance to classes and the evaluation of the school assignments, in a way that the three factors contribute to the establishment of the academic achievement and not only an isolated measure such as the grade given by the teacher at the course's final. The research reports refered by these authors establish that when introducing the AGPA as a measure criterion of academic achievement, there is an immediate improvement in the predictive value of the first entrance evaluations and it reduces, in addition, the predictive differential for gender (Young, 1990a, 1990b and Johnson, 1997).

2.1.1. 2 Methods to Establish the GPA

There are basically two methods to establish the GPA or grade average. The traditional one consists of adding the scores of the different courses and divide its product between the number of included courses. The adjusted one considers the numeric results of the grades obtained by each student in each one of the courses and develops a factorial analysis from them. This method reduces a group of values to a single chain of values that represents it (Young, 1990). This adjustment procedure isnnot based in central trend measures, but in measure of variability to represent a value. With this a more precise way to represent the value of each grade, supported on its relative variability with the other grades, is gained.

2.1.1.3 Different Measures to Academic Achievement

In the report of Lei, Bassini and Shulz (2001), is found a summary of the most important criteria to measure the academic achievement in the North American universities. Among these criteria, the GPA or grade average is outlined, but there are other adjusted criteria such as the additive coefficient, the multiplicative coefficient and the combined coefficient. Another group of adjusted criteria introduced are the RSB (Rating Scale performed by Bigsteps), the PCB (Partial Credit performed by BIogsteps), the PCM1 (partial credit with common slope of 1), the PCMA (partial credit with common slope of Multilog), the GPCM (generalized partial credit by Multilog), and finally, the GRM (grade response performed by Multilog).

For the purpose of this study, it is convenient to consider academical achievement in both modalities. The comparison between them will allows us to contribute to the debate exposed above.

2.2 "Aprovechamiento Escolar" and Academic Achievement

It is important to distinguish the terms of academic achievement and the spanish term "*aprovechamiento escolar"*. In a first approach the concept of "*aprovechamiento escolar"* seems to be, semantically talking, the most appropiate to express the differences in the students academical performance 1. In fact, the concept of *"aprovechamiento escolar"* is part of the package of

1 To English language, *"aprovechamiento"* could be translated as the ling form of the transitive verb *"aprovechar"*, that essentially means *"to make the best of"*. So the meaning for *"aprovechamiento escolar"* could be semantically defined as the measure in which a student makes the best of the school experience.

indicators that the SEP has established to characterize the students performance of the students in the national educational system.

Beyond the semantic affinities among both concepts, these must be differenced attending to the different effects of the evaluation policies in the basic education system and in the other hand, in the high school and college education system. I am referring specifically to the mandatory character of the basic education cycle. Such character has leaded to a policy of automatic accreditation of the students in their transition from one academicals degree to another. Nevertheless, it must be clarified that the reasons of the automatic grade in basic education are psyco-genetically justified according to Piagiet's (1986) phases of development and relating to the evolution of the reading-writing learning theory (Gómez, 1995).

The *"aprovechamiento escolar"* measured trough GPA looses its initial capacity to reflect differences in the performance of students and therefore, as to discriminate academical success and failure.

In the level of technological high school education, as the mandatory character of high school is in discussion as part of the future integral reforms package, it is still a fact that this educational policy is not currently applied. The indicator of *"aprovechamiento escolar"* still reflects important differences in the global students performance, but to use indistinctively the same concept that the SEP uses to describe the performance of students in the first cycle of basic education only brings more confusion between an empty concept that does not reflect the differences that were originally intended (aprovechamiento escolar)

and a second concept (academic achievement) that must be used only for the description of the differences in the performance of students of high school and college education.

2.3 The Intangible Capital Theories

In the context of the intangible capital theories, there are essentially three basic conceptual contributions registered: the social capital theory, mainly represented by Coleman (1998); the cultural capital theory (Bourdieu and Passeron, 1995); and the human capital theories, wich are the clasical version represented by Schultz (1961) and Becker (1964); and the more contemporary version of Rychen and Salganik (2004).

The social capital theory establishes that academical achievement is influenced by the most immediate context of social relationships, where the most important factor are of an interpersonal nature (Coleman, 1988). Coleman (1988) demonstrated that the degree of social development of a community is reflected in the degree of academic achievement of its students.

A second contribution comes from the research studies made by Bourdieu and Passeron (1995) about the concept of cultural capital. The results of their investigations evidenced that language, a factor of symbolic nature, is one of the important element in the explanation of the differences in academic achievement of students. For these authors, the differences in social class , in pedagogical abilities of the teachers, in their capacities for communication, as the differences in their linguistic capacities, explain the differences in the academic success of their students.

McClay (2000) reports a study about the role and the possible effects of cultural capital in the levels of academical achievement of urban familys. This study is complementary to the one held in this dissertation, despite the differences in the theoretical framework. The theoretical model of this study is cultural capital, but there are a number of methodological and technical affinities between this and the other study mentioned above.

Another important contribution comes from the theory of human capital. One version of this theory, denominated as the “classical version” for this study, claims that knowledge and abilities are important elements in the academic productivity of the students. This first theoretical contribution is represented by Schultz (1961) and Becker (1964). The model of human capital that is denominated *“classic”* (Schultz, 1961) is composed by two elements: knowledge and abilities. In the opinion of these authors the subjet productivity wa a linial result of their education and skills

The second version, that we will call the “contemporary” version, claims that beside knowledge and abilities, the key competence factor is determinant in the explanation of the academic achievement of students. The cognitive human capital model (Rychen, Salganik and MacLaughlin, 2001), condiered that it three basi components are the formal reaoning the mathematics abilities and the verbal abilities. In the coneption of human capital from the OECD.the key competence are added to the concept of knowledge and abilities.

This study considered the social and cultural capital’s theories as important antecedents and significant contributions to this problematic, but it

doesn't define measurement models regarding them and the structural model proposed doesn't include them too.

2.4. Human Capital

The most refered author in the specialized literature, founder of the key contribution in the development of the human capital issue, was Theodore Schultz (1961). This author discussed the relation between social wellbeing and human capital. His analysis of the available alternatives for social investment allowed resuming his conception in the next citation: "Investing in themselves, people can extend the range of available choices for them. This is a way for free men to extend their own wellbeing". (1961:98). Schultz presented new explanations for old productivity issues, not yet solved by the econometric models that were common in his time. Traditionally, and even from the classic economy, the idea of capital was discussed as an extension of the concepts of physical and financial capital. The concept of capital goods contemplated only the physical, financial and monetary aspects of the term. This theory, effectively, is limited to tangible aspects only. Only things were conceptualized, not persons. Persons always appeared in economical analysis as a constant, a homogeneous factor and not as a variable. For this reason, when the economists tried to induce changes in the economical dimension, they manipulated things, not persons. The human aspect of capital was not present in their considerations (Schultz, 1961).

The human capital theory is based on what its author, Schultz (1961) describes as evident. This means that, trough the experience of life, each person acquires knowledge and abilities that enrich his own self. This knowledge and

abilities become a resource that improves the productivity of the persons. And since the processes and efforts that a person uses to improve himself or herself are presumably voluntary or intentional, Schultz considers them a deliberated "investment".

Now, the vitality of Schultz's theory (1961) is not contained only in his definitions, but in the understanding of the importance of the fundamental issue. The abilities and knowledge accumulated by persons, regardless of their intangibility; will have tangible, observable and measurable effects over the social, economical and personal realities (Schultz, 1961).

The theory of human capital, expressed by the writings of Schultz (1961), indicates that knowledge and abilities are the two most important components of human capital and both most be privileged in the construction of a model for human productivity measure. The theory must then explain what kind of knowledge and which abilities will effectively portrait the operationalization of human capital as a variable. This issue is treated in the formulations developed by Salganik (2004) from the concept of competences for life.

2.5 Human Capital and Competences for Life

Human capita in this approach is a resulting factor from three aspects: language, formal reasoning and mathematical abilities. The conceptual framework of this investigation question is based on the concept of competences for life. According to Salganik (2004), this concept was explored for the first time trough the Educational Indicators Program (INES) of the Cooperation and Economical Development Organization (OECD, 1992). Its indicators were

focused on three areas: academic success, cognitive abilities and personal development. Regardless, a study published by OECD (1992) could only measure mathematical achievements.

A second source of learning results, comparable on the international ground, showed the indicators that come from the DeSeCo project (2005). This is a study fo a comparative nature. The results for the mentioned study embrace two phases: the results of the first generation, published in 1998; and the ones who come from the second generation, which are developed contemporarily. The definitions of human capital used in this study and the components of key competences that support this theoretical framework are taken from the DeSeCo project (2005) in its second generation.

In the next lines, we proceed to summarize the DeSeCo study in its first and second genearations, with the purpose of hold the formulation and hypotheses of this study.

2.5.1 First Generation DeSeCo Studies: Curricular Competences, Alphabetization and Human Capital

In the study performed by Salganik, Rychen, Moser and Konstant (1999), the basic themes for discussion on competences for life, were curricular competences, adult alphabetization and human capital. The subject of human capital is particularly important since it conceptually situates the theoretical basis of Salganik, Rychen, Moser and Konstant approach (1999). In this perspective, human capital is redefined based in the concept of key competences, that are of a cognitive nature. It was also significant that the concept of human capital was

retaken as a factor that impulses academic achievement, as it was originally in the approach of Schultz, but now in a more organized dimension.

The distinction between the two result indicator categories was published in a study published by OECD (1997). This dissertation considers only the first of this two: human capital in the curricular context. Since 1993, the Curricular Competences Viability study has been developing; and consequently, the question of which competences are important because of their impact on the different areas of the curriculum was formulated. Those competences were called “generic”. For the subject of adult alphabetization, the National Adult Literacy Survey (NALS) distinguished and defined three kinds of alphabetism: literary alphabetism, document alphabetism and quantitative alphabetism. These three distinctions were the basis of what later was considered as one of the three key competences in the second generation investigation: the abilities related to the language use.

In 1998 the OECD published the different perspectives from which the human capital concept was understood were recognized. Also a definition for human capital is proposed, wich says that “… knowledge, abilities and competences and other attributes of the individuals relevant for the economical activity” (OECD, 1988, p.3).

2.5.2 Second Generation DeSeCo Studies: Design of Measurement Instruments

The so called second generation studies are focused in the design of measurement instruments. Among these instruments, the International Program for Student Evaluation (PISA, 1999) is the most important, from the point of view

of the theoretical foundations of this dissertation proposal. This study attends to the need to count on comparable data for educational indicators. Basically, the PISA report (1999) is focused on reading alphabetization, mathematical alphabetization and science alphabetization. Its goal its "… to evaluate to which point the young have acquired in this areas more knowledge and abilities that will be useful in their adult life" (PISA, 2003, p. 3).

The base of this approach is the concept of learning for life. Even when, initially, PISA (1999) only embraced reading, mathematics and science; from the beginning it was contemplated to include intra-curricular competences and information and communication technologies. In 2003, only evaluations that tend to measure formal reasoning, mathematical skills and language skills are included. For the future , the PISA evaluations aim to consider indicators that characterize motivation for learning, learning strategies and the citizen on his interaction with the rest of the citizens.

Second generation research understand human capital as a conjunct of factors: language abilities, resources for the learning of mathematics and formal reasoning. Those factors are, from this approach (DeSeCo, 2005) the explanation of academic achievement.

The DeSeCo project (2005) had as a goal to select and define the group of comptences that hold the theoretical framework in which the OECD researcher's work. To analize the contributions of this group of authors, their contributions have been broken down, differencing the contributions dated in the first generation, which were centered in the analysis of the curricular aspects

related to the selection and definition of key competences. There was also summarized a group of studies that were refered as secon generation studies. These last studies considered the design, the making of the pilot study and the construction of an evaluation instrument held in the group of conceptual contributions, a prioritary issue.

2.6 The Concept of Competence

The concept of competence requires a rigurous explanation, according to Waynert (2004). This lack of clarity in the concept is widely compensated by this author. This lack of clarity in the concept is widely compensated in this author with an extense effort aimed to a define competence and the implications underlying this concept. Although the concepts of capacity, qualification, ability or efficiency are treated in general sense as synonimous of competence, neither are they defined with precission nor are they differenced with clarity. The example analysed by this author is the one from the Webster dictionary ( ) where competence is defined as aptitude or capacity. Around this two concepts, the mentioned dictionary refers those of efficiency, dominion and ability.

Weynert (2004) states a distinction between the sense of the word competence for natural sciences and for social sciences. This last sense is the one that concerns to the matter of this study as it is pertintent for sociology, psychology, linguistics, political science and economy. In this respect, Weynert (2004) says that for all this disciplines the word competence is interpreted as a quite specialized system of abilities or capacities that are necessary for the achievement of a certain goal. Theese abilities or capacities pressume a

determined learning and the possibility of vinculate it to the resolution of specific problems.

Another relevant aspect relates to the dimension in wich the competences are portrayed. This distinction is treated in detail in a study by Carson (2004), where the difference between the individual and collective dimension of competence is stated

In Weynert (2004), competence is understood as a system of abilities or capacities sufficient for the completion of a goal, that can be applied to an individual and the distribution of such competences in a group or social institution.

An important contribution by Weynert (2004) is the aknowledgment of the wide variety of senses for the concept of competence and the great diversity appreciated in the uses of such meanings. For that reason, his conclusion about the possibilities to articulate a conceptual structure sufficiently organized to hold a theoretical explanation about competences is justified. In this respect, he potnts out that it is not possible to discern or infere a coherent theory from this multiple uses. There isn't a theoretical basis for a definition or classification from the apparently infinite inventory of ways to use the term competence. However, in Waynert's opinion (2004) there is a group of conceptual approaches that can be the infrastructure to hold the refered theoretical basis.

2.6.1. General Cognitive Competences

In Waynert's approach (2004), competences are understood as abilities and capacities of a cognitive nature. These are general intellectual abilities that

include all the menthal resources of an individual. In this respect there are three conceptual approaches that can be distinguished. The first of them relates to the psychometric models of human intelligence. For those, intelligence is a human competence and it is chartacterized as a system of a system of abilities free of content and context (Carroll, 1993). The second conceptual approach, in terms of general cognitive competences, is the methodology of information processing. Intelligence in this approachis a general competence trough which the subject gains an infinite variety of abilities and knowledge. The third approach is identified expressly as Piaget's. The secuence of steps in developments conduct the subject to an abstract and flexible knowledge and to progressive action competences (Piaget, 1947).

2.6.2. Specialized Cognitive Competences

From this approach, the calssification and description of specialized cognitive competences is important. Such specialization is related to certain groups of cognitive pre-requirements that must be available for the indivdual to be able to function in a certain area. Naturally, each particular area will demand a redefinition of the respective cognitive competences which are particular to it. Leplat (1997) has established the advantages of the specific performance approach, compared to the ability centered competences approach.

2.6.3. The Competence-Achievement Model

This model is held in a basic distinction between the concepts of competence and achievement (Chomsky, 1980). For Chomsky, the linguistic competence is inherited ability and therefore it is universal. A basic system of

competences that, when set to an specific learning process, will allow human beings to acquire the mother tounge and therefore it will allow him or her to articulate gramatically acceptable statements. The adquisition of language is a product of the relation between competence and achievement. As a sub-product of this approach, the concept of competences in the theory of discourse can be quoted (Hymes, 1967).

A modification of this approach is the competence-moderator-achievement model (Overton, 1985) where the relation between achievement and competence is moderated by other variables, for example the cognitive style and memory, among others.

2.6.4. Cognitive Competences and Action-Motivation

The relation between cognitive competences and action-motivation trends was established by White (1959). In the definition of this author, competence is an effective interaction of the subject with the enviroment. He proposed an intrinsic need to face the enviroment and from that this author detaches the importance of the feeling of effectiveness and motivation for the competence. When an individual is competent, he develops an achievement experience that has a motivational value and impacts his future performance. Therefore, the self concept of the subject has a special value in this author's approach. He distinguishes, for example, a level of "self" by characteristics and a level of "self" by state. Another author, named Epstein (1973) quoted by Weynert (2004) differs the concepts of "self" for levels of generality. The highest level would be the "global self" level, wich is the more general and describe the individual as highly

self confident. Another level would consider the personal evaluation in different areas such as phisical attractive, social status, intelectual capacity and moral capacity. The next level of self concept is related to achievements in very specific areas such as mathematics, sports and foreign languages, among others.

Sembill (1992) makes a distinction between objective and subjective competences. The first are the achievements and the dispossition to achievement, than can be measured trough scales and tests, as the second are defined as the subjective valoration of relevant abilities for the performance, which are necessary to solve problems. Finally the concept of subjective competence has been divided by Staudel (1987) in three sub-definitions: euristic, epysthemological and actualized competence.

2.6.5. Action Competences

This approach describes a type of competence that includes all the motivational and social cognitive pre-requirements that are indispensable for a determined action to be successful. The elements that compose an action competence model are: solving problen ability, critical thinking, knowledge on the subject in general and particular sense, self confidence and social competences. Although traditionally this kind of competences are described in the individual order, it is possible to establish achievement objectives for groups and institutions.

2.6.6. Key Competences

In the wide debate over the theory of competences, the concept of key competences has occupies a privileged space. In press as in everyday

conversation, this concept is also positioned as mandatory topic for the analysis of the educational reform of 2004. And, in the opening of the forums about the integral reform of 2008. That justifies the pertinence of Weynert's question: why does the key competences concept results as such an attractive one?

In this author's definition, the term is generally refers to multi-functional and transdiciplinary useful for the achievement of many important goals, to master diverse tasks and to perform in unknown situations (Weinert, 2004). Is this wide spectrum competence condition, of multiple function condensation, trough a wide group of disciplines, what provides the elected competence with a privileged value.

The key competence would appear as a metha-competence, a cognitive ability that qualifies us to develop in a global way the rest of the important competences. For the educational policy analysts this concept is attractive because it separates the idea of an overloaded curriculum and focuses it in a few key competences. Naturally, the matter is under which criterion the condition of key competence is established in a competence.

According to Weinert (2004) there is a wide spectrum of competences that the specialized literature refers as key competences. Among them are: the mother toungue's oral and written mastery, mathematical knowledge, reading competence for fast acquisition and adequate processing of written information; the mastery of at least one foreign language, the competence of the means, the independent learning strategies; social competences; divergent thinking, critical judgments and self criticism. In some way, these competences have already

been formally and widely recognized inside and outside the specialized literature. The criteria in which their selection as key competence is held are the ones proposed by Weinart (2004). In the next lines they will be described:

- Key competences are defined in different abstraction, generality and universality levels, there isn't a theoretical model that represents them in an accurate way. It is important to establish a normative reference framework-not only empirical- as a context for the definition of the key competence.
- The key competences are knowledge, beliefs and action systems that are built from the mastery of a group of basic abilities. There are psychological components that are considered in some cases as part of the key competences and that must be defined in such a way that they do not give place to a psychological discrimination.
- A common prejudice to the possibilities of education and socialization in general terms, is related with the key competences. This prejudice establishes that learning how to learn and learning the electronic means to locate the information will substitute the need of the citizens to learn specific contents. The more the general the key competence, the less the applied capacity to solve a wide variety of problematic situations.
- In general sense, key competences can't compensate their lack of specific content (Weinert, 1998). By themselves, the key

competences have no practical use. It is the expereince that allows the general competence to actually function.

- Finally, relating to many of the refered key competences, the basic issue is if they can be effefctively developed in the subject trough programs of planified training. The example for this discussion is critical thinking.
- An important discussion about key competences is related to the concept of metha-competence. The concept is a derivation of the reference framework of contemporary psychology denominated metha-cognition. This concept is relate to the knowlegde we have abour knowledge itself. The case of metha-competence is define by Nelson and Narens (1990) as the ability to judge, the availability, use and quality of the learning of the personal competences. It is a competence that allow the knowledge and application of a wider group of competences.
- In general, the results of the metha-cognitive studies are important for the development of a theoretical conceptualization about competences in general sense and in a very particular way, for the topic of the key competences. The metha-coignitive studies outline the role of introspection in that process, as it is the baisis of the psyuchologic processes for learning, memory and thinking.

As a conclusion, Weinert (2004) establishes that it isnt possible to offer a unified definition for the concepts or competence and metha-competence. About

competence, however, he outlines that the concept refers to the pre-requirements necessary that are availabe by a group or individual for successful achievement..

CHAPTER 3

METHODOLOGY

The purpose of this section is to present the methods used to conduct this proposal. First, the research design, the description of the population to be studied and the sampling design are exposed. To continue, the measure instruments and the variables to be considered will be detailed. The procedures for data collection, data processing and finally the design of the statistical analysis of data will be developed to evaluate the research hypotheses.

3.1 Research Design

The design of the research proposed belongs to the category of studies denominated secondary data analysis and intends to characterize the important variables, in a separated way and in their interrelation.

The exogenous variable of the study are the key competences (mathematics, logical reasoning and language), which were measured trough the results of the achievement of the students of technological high school during their first entrance evaluation trough the standardized test made by the COSNET in september 2005.

The endogenous variable is the academic achievement, measured trough the scores in the semester evaluations of the same students processed by their teachers in January 2006.

Given the existence of an institutional investigation line from OECD for over 20 years, this study demands a confirmatory approach in the analysis of the data and, given the importance of establishing patterns of relations among the variables a *priori*, the use of technical resources of an inferential nature was considered. It was considered an strategic need to incorporate tools that analyze in a systematical way the error in the different dimensions in which it occurs in the variable measures. Given the latent nature of the exogenous variable and the also latent nature in the option b of the endogenous variable, it was necessary also to choose a methodology that permits the processing of latent data.

Finally, given the limited variety of procedures and the great difficulty of certain cases to find the tools to perform the multivariate modeling of relations between variables, in this study we considered the use of tools of covariance analysis, particularly the Structural Moments Analyzer, also known as AMOS (Arbuckle and Wothke,1999; McCallun and Austin, 2000).

3.2 General Characteristics of the Population Studied.

The population of this study is composed by students that enter to technological high school in September 2005. They are teenagers (fifteen years old average) both sexes. Most of them come from the socially segregated zones of the seven geographical areas of Nuevo Leon state. Geographical zones co-respond to the areas where technological high school institutions are. The technological high schools in Nuevo Leon are: CBTis 22 in Monterrey, CBTis 99 in Monterrey, CETis 101 in Guadalupe N.L., CBTis 74 in Guadalupe N.L., CBTis 53

in Apodaca N.L., CBTis 258 in Escobedo N.L. and CBTis 163 in Montemorelos, N.L.

3.2.1 Locality of the Study

The subjects of this study are from different communities in the state of Nuevo Leon. Despite that fact, the data for the independent variable (the first entrance evaluation of 2005) and for the dependent variable (the semester evaluation of January 2006) are available for consulting in the digital files of the XIX Zone Coordination of DGETI in Nuevo Leon. Consequently, it is possible to make the indirect collection of this data without having to consult the specific files of each involved school.

3.3 Sampling and Procedures

The sample is formed by first grade students, both genders, enlisted in DGETI schools in Nuevo Leon state that went trough the High School Entrance Evaluation in September 2005 and concluded their first semester in January 2006.

The study considered students that participated in the evaluation in September 2005 and finished their first semester in January 2006.

Initially, the 2064 that participated in the Technological High School First Entrance Evaluation in 2005 were considered. Now, considering the high school drop-out (up to 19% in first semester), as well as the incidence of other factors;aproximately 81% of the student originally registered are part of this study. The final sample is then 1610 students.

The definition of the sample size from a multivariate angle demanded different criteria. The number of manifested variables in the model was accounted

and multiplied by fifteen. The multivariate requirement for the size of the sample for the measure factorial model of the independent variable resulted in **390** cases, following the criterion pointed out by Stevens (1996). In the case of the final model, the so called structural model, up to 30 manifest variable were considered, and therefore the sample should not be less than 450 cases.

Other authors as Bentler and Chou (1987), agreed with Steven's criterion; although, they have establishes that same criterion but considering the parameters to be estimated (by 5) and not the manifest variable (by 15) by themselves. Nevertheless, the five parameters from Bentley and Chou (1987) to be estimated, always consider, at least , one residual term and a path coefficient for each parameter to be estimated. Finally, they are 3 by 5 and that way it matches Steven's criterion for the number of manifest variables, by 15.

In a different criterion, Loehlin (1992) established, after an exhaustive review of the literature, that 100 and 200 cases were an adequate sample for this type of studies. For the initial model and the final model, the size of the sample for this study widely exceded the requirements of Stevens (1996), Bentler and Chou (1987) and Loehlin.

The study intends to establish conclusions about a universe of 4,542 candidates that were enlisted for technological high school in the state of Nuevo Leon during September 2005. Due to the administrative critera of DGETI in a federal level, only the first 2,064 of these students went trough the exam developed by COSNET. Cases were obtained directly from the registries made by the XIX Zone Coordination and the selection must include every registry that

includes the listing for the First Entrance Evaluation of September 2005 as well as the Semester Evaluation of January 2006, wich provides a ver robust sample.

3.4 Measurement Instrument

The measurement instrument for the independent variable is the First Entrance Evaluation Questionnaire of COSNET, September 2005. The instrument applied in the evaluation was formed in three segments where the level of development for formal reasoning (eight categories with thirty two questions), capacities for the learning of mathematics (eight categories with twenty four questions) and verbal abilities (four categories with fifthy four questions) were evaluated. In total one hundred and ten questions. For each of the three segments, composite measures were generated. In total they were 20 cathegories which we refered as sumated scales.(8, 8 and 4).

Table 3.1 Factor, Category and Items.

FACTOR	CATEGORIES	ÍTEMS
Formal reasoning	RF1, Compensaciones multiplicativas	24
	RF2, Pensamiento correlacional	
	RF3, Pensamiento probabilístico	
	RF4, Pensamiento combinacional	
	RF5, Pensamiento proporcional	
	RF6, Formas de conservación sin verificación directa	
	RF7, Equilibrio mecánico	
	RF8, Coordinación de dos o más sistemas de referencia	
Mathematics abilities	MT1, Comprensión de los enunciados que se leen	24
	MT2, Capacidad para establecer inferencias lógicas	
	MT3, Capacidad para realizar generalizaciones	
	MT4, Abstracción reflexiva	

Table 3.1 Continued

	MT5, Capacidad para establecer relaciones	
	MT6, Capacidad para comparar relaciones	
	MT7, Capacidad de simbolización	
	MT8, Capacidad de imaginación	
Verbal abilities	HV1, Comprensión de lectura	54
	HV2, Analogías	
	HV3, Complementación de enunciados	
	HV4, Antónimos	
TOTAL	20	110

3.4.1 Instrumentation and Variable Measurement Tools

To conduct the analysis and interpretation of the data obtained in the verbal ability, formal reasoning and mathematic ability tests, denominated key competences, it is necessary to have a comparison framework that responds to what is desirable. For the authors of the evaluation (COSNET) this comparison framework is as described below:

- Formal reasoning: It's the intelectual act made by the subject to appropriate of the characteristics of an object, fact of phenomenae wihotu the need for the subject to be present. In this ability, it is desirable that the students answer, as minimum, eighteen of the thirty two uqestions correctly. This means they must be in the level of low formal reasoning, or high.
- Capacities for the learning of mathematics: the potential that the subject posesses to achieve intelectual action with success in the area of mathematics. In this ability, it is desirable that the students answer correctly at least twelve of the twenty four in the test, for them to achieve, at least, the medium domain level.

- Verbal ability: the minimum desirable criteria are for the accepted candidates to answer, at least, thirty seven of the fifty four questions correctly, for them to be in the level of domain.

3.4.1.2 Dependent Variable: GPA

The interpretation framework for the evaluation of academic achievement considers the qualification measure obtained in six assignments for each one of the first semester students in the semester evaluation of January 2006. Those assignments are algebra; english; chemistry; reading, written oral expression; science, technology, society and values and technologies of information and communication. Nevertheless, compared to a factorial measure model of the dependant variable, the predictive validity of independent variable significantly improves.

3.5 Research Hypothesis

The main research question fo this study asks if the key competences are significant factors in the explanation of academical achievement. The research hypotesis for this study (H1) holds that key competences influence academical achievement significantly. From this key competences, the ones related to mathematical literacy, language literacy and logical reasoning literacy are significantly important.

3.5.1 Model Specification

The model specification is sustained in a theoretical-hypotetical formulation that supposes linearity between human capital and academic achievement. Consequently, this research hypothesis can be expressed in the next way: La =

CH + e, and therefore: La = hv + hm +rf +e. **La** is academic achievement, **CH** is Human Capital **e** is the error, **hv** is verbal abilities, **hm** is mathematics abilities and **rf** is formal reasoning. Attending to the research hypotheses it proceeds first to design a measurement model for each of the key competences, a human capital measurement model and finally, a structural model that to establish the relations between the measure model of the exogenous variables and the measure model of the endogenous variable.

3.5.2 The Re-specification of the Measurement Models

The analysis of the factorial model for verbal ability, mathematical abilities and formal reasoning allowed to validate the condition of multi-variate normality of the sample, being supported in the respective Mardia's coefficient (1980) and it also allowed to adjust the values out of range or outliers, trough the analysis of the Mahalanobis's distance (Trochim, 2003; Hair, Anderson, Tatham and Black, 1998). Basically the intention was to establish if the group of sub-scales loaded the hypotetized factor. When this happened, a measure adjustment evaluation was performed and when that didn't happen, a re-specification of the measure model was conducted (Kline, 1998).

3.5.2.1 Specification of the Measure Model

Given its condition of latent variable, accesed indirectly trough its effects, human capital requires a measure model for non-directly tangible variables, in other words, a factorial type model. The measure model of the exogenous variable

expresses the theoretical assumptions of the human capital in the contemporary version and suposses that sumated scales and indicators will be grouped in each case around its factor loading. Theese three factors -mathematics, language abilities and formal reasoning- will be grouped around our exogenous construct: human capital. To evaluate normality and in its case, to adjust values out of range; Mardia's coefficient was used as well as the analysis of the Mahalanobis's distance. Thye factorial model was validated trough the factor loading report. Finally, the measures of goodnes of fit measures. The next figure expresses the hypotesis where an interrelation between the key competences is formulated.

Same time that factorial measure model is vinculated, under the shape of an structural model, to the endogenous variable : academical achievement.

3.5.2.2 Specification of the Structural Model

The specification of the structural model considers the measuring model of the exogenous variable as the measuring model of the endogenous variable.: the manifested (GPA) and the latent (factorial AGPA). The manifested endogenous measuring model (the average variable) is one of the dependant variables and the endogenous-latent measuring model (the adjusted factorial) is the other dependant variable to be compared. This endogenous dependant can be a manifest endogenous or it can be sustituted by an endogenous-latent variable. The endogenous variable is a dependant. Manifest is the name given to the variable that relates to GPA and latent is the name given to the variable associated to the adjusted factorial.

3.6. Procedures for Data Processing

Data processing for this study was developed using the statistical software for social sciences called SPSS. Specifically, the most recent of its modules was used, the one related to structural moments analysis. The reason to perfomr the statistical calculations trough this software is that it simultaneously performs two well differenced mathematical procedures: a factorial analysis and a multiple regression.

This SPSS module is specifically designed to work with big samples and it is provisioned of modules to establish multi-variate normality, to adjust non-normality problems; to establish factorial of measurement and for making decisions based on a wide spectrum of indicators of goodness of fit measurement. Non of this characteristics are present in earlier modules of SPSS.

Finally, the module of structural moments of SPSS was used because it is the only one that allows to perform regressions of the factorial models in a simultaneous way. The most recent literature not only reccomends the use of this module of SPSS for research on economy, sociology and psychology but also claims that this software has been specially designed for this sort of purposes. (McCallum and Austin, 2000)

For the data processing the further actions were taken:

- Assumptions, normality and data adjustment.
- Analysis of the first order factorial measuring model for each of the exogenous sub-scales.
- Analysis of the factorial measuring model for key competences

- Analysis of structutral modeling.

3.6.1 The Hypotheses

In this section it will be showed the main hypotheses that were considered for this study.

- H0: key competences are not important factors in the explanation of academic achievement.
- H1: key competences are important factors in the explanation of academic achievement of high school students.
- H2: language is the key competence that best explains academic achievement.
- H3: mathematical abilities are the key competence that best explains academic achievement
- H4: formal reasoning is the key competence that best explains academic achievement.

3.7 Limitations of the Study

An intial limitation is related to the characteristics of the sample. Although it was originally intended to include the eight schools of DGETI in Nuevo Leon, in the databases consulted, only seven of them were accessable. This initiall decrease in the size of the sample impacted the generalization of results. That explains the importance of reprising the study in different, wider contexts. A second limitation is the fact that the schools in the sample are from Nuevo Leon only, restricting its representativity as a sample. A third limitation has to do with the instrument of measure, due to the fact that its data wouldn't allow a factorial

validation in its three components. This circumstance demanded the re-specification of the measurement model of the key competences, now considering only the two components validated in their factors. Different from the original model, the model that just incluide verbal and mathematical abilities can be hold in its latent variant as in its manifest variant.

A fourth limitation is relate to the conceptual frameworkl of the key competences model in its original version, as it considers GPA as its dependant variable. The results of the study represent a critic to the traditional conception of GPA as the model of the AGPA demonstrated a greater predictive validity.

Aditionally, the results of the study must be interpreted as a critic to the use of qualifications provided by the teachers as a valid, trustable measure, held in the academical achievement of students.

Another of the limitations of this study is the impossibility to directly access, item by item, to the prime subject of this study, the integral databases of the evaluation performed in 2004. The sumated scales as the sub-scales were used. Another limitation of a formal nature is that the sub-system SEMS doesn't have a structure that holds the condition of cotidian work of scientific research, so research cannot be performed any further than weekends. Besides, there exist personal limitations of the researcher as an instrument for this research.

Aditionally, it is important to develop an evaluation of the theoretical model that holds the study, as the methodology used. The human capital model of OECD held a structure of three components, in which each one of them had an equivalent weight.

The results of the study represent a critic to this model as they can justify its re-formulation to one of the two factorial components: mathematical abilities and verbal abilities. The results of the study also question the specific weight of each factor, giving the verbal abilities a weight significantly greater than the one reported for mathematical abilities.

A third theoretical questioning is related to the explanatory capacity of the model. Although, the original formulation of the OECD only includes three elements, in the structure of the human capital model the results of the study allow to claim that there exist other important variables in the explanation of academical achievement. The study establishes, between its most important findings , that the explanatory capacity of the model is narrow and at the same time holds that such limited capacity is significant.

About the methodology oif the study, although its selection was founded on the assumptions that justify a methodological approach of this nature, and although such assumptions are held at the same time in the suggestions that the specialized literature shows, the structural ecuation modeling still depends on not always standardized nor unified criteria.

The determination of the sample size for multi-variate studies depends of uniform criteria, but not always these are clear or explained in detail. Even thoug, they are operative and allow to make decisions about how many cases are necessary to run the databases.

The software used in this study for structural ecuation modeling do not offer the criteria for the interpretation of Mardia's coefficient, nor to establish the edge in

the analysis of Mahalanobis's distance, nor to decide if the factorial measurement model is or isnt valid, nor to determine how to interpret the proportion of explained variance of the factorial components of the dependant variable (in case of standardized facorial loading), nor in the case of the square multiple co-relation as an elemnt to interpret the proportion of global explained variance of the model for its dependent variable, which is academical achievement.

About the current thirty element criteria for the completion of the analysis of the goodness of fit measures, it can only be added that each on of them responds to a different criterion and that to evaluate that criterion will always be complementary between the available coefficients. The researcher has to solve each one of the mentioned ellements of criteria and can only advance up to the point where he is able to comprehend the specifi sense of each process in every replay of the adjustment that goes around re-specifying its own structural model.

CHAPTER 4

RESULTS

The general results of the study, generated though the group of statistics procedures, will be exposed in this chapter. Initially, it exposes the results of the sample's demographic variables and their comparision with the current national estimates. Then, the results regarding the desciptive analysis of the dependent and independent variable will be presented, followed by the results of the endogenous and exogenous measurement models. Finally, the structural measurement model is evaluated, comparing the case of the manifested and latent dependent variables.

4.1 Distribution of the Demographic Variables

The distribution of the socio-demographic variables is important in the extent that they offer a description of the context's elements that could be significative in the more general frame of the study results' interpretation. It also permits to establish the elements of the specific context that facilitate to make cuts in the study in attention to their socio-demographic conditions. Among them, the participation's percent of DGETI schools in Nuevo Leon, the type of junior high school of precedence, the year of junior high school graduation, as well as the age, gender and carreer's percentage were considered.

Table 4.1. Participation's Percentage of the DGETI Schools in in the Sample.

Schools	Frequency	Percentage
CETis 163	203	12.6
CETis 101	435	27.0
CETis 066	206	12.8
CBTis 099	205	12.7
CBTis 074	130	8.1
CBTis 022	431	26.8
	1610	

Table 4.1 above shows that the participation's percentage in the sample per school goes from 8 to 27%. More than half of the sample concentrated in two schools: the CBTIS 22 and the CETis 101. There were two schools in Nuevo Leon that did not participate in the sample: the CBTIS 258 and the CBTIS 53.

Table 4.2. Participation's Percentage for Junior High School of Procedence

Type of school	Percentage
Other	.6
Technical private school	.8
General private school	.7
Telescondary state school	.4
Workers state school	.2
Technical state school	13.0
General state school	31.6
Tele secundary federal school	2.4
Workers federal school	.3
Tecnical federal school	27.8
General federal school	20.3
Workers private school	1.8

Table 4.2 above shows that the participation's percentage for junior high school of procedence point out that the main sources are the state and federal schools, while the general an technical private schools have a minimal participation. In the sample participated federal schools with a 50.8 %, the state schools with a 45.2% and finally, the private technical and general private schools with a 3.3 %. It is concluded that in the DGETI subsystem of Nuevo Leon, most of

the students came from the federal system of technical and general junior high schools.

Table 4.3. Percentage of Students for Graduation Year in Junior High School

Año en que concluyo la secundaria	Porcentaje
2005	82.2
2004	12.0
2003	3.5

Table 4.3 above shows that most of the students of the sample have recently graduated from junio high school. They are barely 12% that graduated in the 2004 and only a 3.5% graduated in the 2003. 97.7% of the population concentrated between 2003 and 2005.

Table 4.4. Age Percentage

Age	Percentage
21	
20	00.3
19	00.4
18	00.7
17	03.9
16	13.2
15	50.9
14	29.5

As regards ages (see table 4.4 above) of the students that participate in the sample, it outlines that the age rank with the highest population is the one of 15 years with a 50.9 %, followed by the age rank of 14 years (29.5%) and the age rank of 16 years (13.2%). Basically the students that enter the system and participate in the first entrance evaluation oscilate between 14 and 16 years old.

Table 4.5. Gender Percentage

Gender	Percentage
Female	40.9
Male	56.0
No answer	03.0

Table 4.5 above shows that there are still more males than females among participants registered in the technological high school education system. The difference between the male and female population is 15%. Even though, it can be considered that in this educational choice the percentage of females registered has increased in the last years.

4.2 Results of the Desciptive Analysis

In this part, the results of the descriptive analysis will be displayed. The tables are the best reference.

4.2.1 The Dependent Variable

The dependent variable of the model took in count the results of the grades of each one of the students in the sample, in the six corresponding courses. Table 4.6 shows the central tendency statistics regarding the six courses and the GPA.

Table 4.6. GPA, Standard Deviation, Standard Error of Kurtosis and of Skewness

	GPA	Química	Algebra	ING	LEO	CTSV	TIC
Mean	7.10	7.02	6.34	6.98	7.09	7.75	7.42
Std deviatior	5	1.56	1.43	1.60	1.63	1.71	1.62
Kurtosis	-.772	-1.123	-.526	-1.094	-1.166	-1.102	-1.107
Skewness	.069	.089	.723	.204	.092	-.331	-.162
Error S Kurtosis	**.120**	**.120**	**.120**	**.120**	**.120**	**.120**	**.120**
Error S Skewness	**.060**	**.060**	**.060**	**.060**	**.060**	**.060**	**.060**

Note: Normality criterion is a value of error estándar of kurtosis and skewness less than a +-1.96. p= 0.01

This six assignatures belong to the dependant variable of the study. The purpose of table 4.6 is to offer a statistc proof criterio that allows to evaluate normality in the group of data that compose each sub-scale. The normality evaluation of the dependent variable GPA attended Hair, Anderson, Tatham and

Black (1998) criterion, that establishes what he calls they called the “thumb rule”. This criterion of cut is held in the standard error of kurtosis an skewness. In all the cases, including the six grade GPA, the estimate values of the standard error of kurtosis and skewness are lower than +-1.96 with a p= 0.01. Consequently, it fails to reject the assumption of univariate normality and it accepts that provisionally those scores are normally distributed. In this evaluation, the suggestion of Hair, Anderson, Tatham and Black (1998) was considered. They recommend two graphic tests a statistical test as a resource to evaluate normality.

In the histograms exposed, bi-modal behaviours are observed, but in general terms, the dependant variable can be considered as visually normal. This apreciation is founded particularly in the behaviour observed in the histograms from figure A1 to A7, in appendix A; the graphic tests named normal Q-Q plot and detrended normal Q-Q plot of the six courses from figure A8 to A21; and even GPA in figure A19. All theese report a behaviour that shows the dots being very near to the line in the graphic in the Q-Q plots, as they show opossition to the horizontal line in the detrended Q-Q plots. This indicates normality. Graphics from A1 to A21 are available to be looked up.

From the point of view of the statistical test, supported in the standard error of kurtosis and skewness (see table 4.6), the reported values were under the criterion of cut +-1.96 wiht a p= .01, and therefore the dependent variable and its subscales are normal distributed.

4.2.2 The Independent Variable

As regards to the independent variable, some desciptive analysis, such as central tendency examinations for each one of the subscales of the components were done. Like the analysis of the dependent variable, a normality evaluated test was included considering the standard error of kurtosis and the standard error of skeweness. Table 4.7, 4.8 and 4.9 illustrated the summarized results of the descriptive analysis. They included mean standard deviation, kurtosis skewness, standard error fot he kurtosis and skewness for each one of the three sub-scales of the independent variable. The three tables are exposed next.

Table 4.7. Subscales of Formal Reasoning of the Independent Variable

	Rf1	Rf2	Rf3	Rf4	Rf5	Rf6	Rf7	*Rf8*
Mean	.71	.96	.23	.86	.13	.85	.84	*.78*
Std D	.83	.85	.24	.83	.96	.84	.87	*.83*
Kurtosis	1.54	-.165	.197	.148	.381	-.377	.382	*659*
Skewness	1.209	.593	.850	.742	.538	.633	.895	*.931*
Error S Kurtosis	**.122**	**.122**	**.122**	**.122**	**.122**	**.122**	**.122**	**.122**
Error S Skewness	**.061**	**.061**	**.061**	**.061**	**.061**	**.061**	**.061**	**.061**

Table 4.8. Subscales of Mathematics Abilities of the Independent Variable

	Mt1	Mt2	Mt3	Mt4	Mt5	Mt6	Mt7	Mt8
Mean	.71	.77	.94	.94	.71	.49	.65	.62
Std D	.74	.80	.93	.86	.76	.65	.68	.68
kurtosis	-2.34	-.252	-.501	-.543	.117	.122	.122	.122
Skewness	.709	.719	.679	.528	.829	1.049	.613	.744
Error S Kurtosis	**.122**	**.122**	**.122**	**.122**	**.122**	**.122**	**.122**	**.122**
Error S Skewness	**.061**	**.061**	**.061**	**.061**	**.061**	**.061**	**.061**	**.061**

Table 4.9. Subscale of Verbal Ability of the Independent Variable.

	Hv1	Hv2	Hv3	Hv4
Mean	3.07	3.05	3.32	3.03
Std deviatior	1.54	1.90	1.86	1.82

Table 4.9. Continued

Kurtosis	-.053	.848	.179	.113
Skewness	.375	.801	.591	.603
Error S Kurtosis	**.122**	**.122**	**.122**	**.122**
Error S Skewness	**.061**	**.061**	**.061**	**.061**

The normality test took as a reference point the standard error of the kurtosis and skeweness estimates (Hair, Anderson, Tatham and Black, 1998), as shown in table 4.7, 4.8 and 4.9. Since these values are under +-1.96, at the p=0.01, they fail to reject the normality assumtion. This means that these variables are provisionally considered normally distributed.

The graphic tests (figures B1 to B24 in appendix B), as well as the statistical tests (Table 4.7, 4.8 and 4.9), hold the difficulty to reject the normality assumption in the three sub-categories of the independent variable (verbal skills, mathematical abilities and formal rerasoning). Consecuentlly, it can be provisionally affirmed that the independent variable is normal.

4.3 Results of the Analysis of the Factorial Measurement Model

This section describes the results of the analysis of the factorial measurement model.

4.3.1 The Subescale of Verbal Ability

The tables shown be low describe the evaluation of the subescale of verbal ability.

Table 4.10. Multivariate Normality for Verbal Ability

Evaluación de normalidad						
	Min	Max	Skew	c.r.	kurtosis	c.r.
hv1	0.00000	9.00000	0.42573	6.98681	0.10001	0.8206
hv2	0.00000	11.00000	0.83001	13.62153	0.93396	7.6637
hv3	0.00000	10.00000	0.59516	9.76735	0.18031	1.4795
hv4	0.00000	10.00000	0.60614	9.94754	0.10025	0.8226
Multivariate				Mardia Coeficients=	1.95883	5.6828
Multivariate					1.80563	5.2335
Multivariate					1.72664	5.0030

Table 4.10 shows, in the intersection between kurtosis and multi-variate, the Mardia's coefficient. Considerint the values of this coefficient, the four sub-scales analyzed have multivariate normality. The three values of the Miardia's are between 1 and 10 points, and this value impproved in each adjustment. The criterion of cut establishes that the values between 1 and 10 present a good level of normality; between 0 and 1, an excellent normality level and over 10 is not acceptable. Based on the last adjustment to the Mardia's coeficient (1.72), it can be claimed that the 4 subscales of the independent variable have a multivariate normal distribution.

Table 4.11. Mahalanobis Distance of the 4 Sub-scales of Verbal Ability.

Higher scores of Mahalanobis distance			
Observation	Mahalanobis		
Number	d-squared	p1	p2
1373	18.59243	0.00094	0.78296
1543	18.52386	0.00097	0.46703
1240	18.48836	0.00099	0.21669
1254	18.42926	0.00102	0.08484
1253	18.49748	0.00099	0.79641
1453	18.30190	0.00108	0.51844
1452	18.30784	0.00107	0.82320

Note: Outliers= p1< 0.001.

Table 4.11 shows the Mahalanobis distance values of the verbal ability subscales. The adjustment to improve the Mahalonobi's distance considers to eliminate the cases that have a significance (p1) below 0.001. Trough that procedure the first, second, third and fifth case were eliminated, until the values adjusted to 0.001 of the percentage of trust.

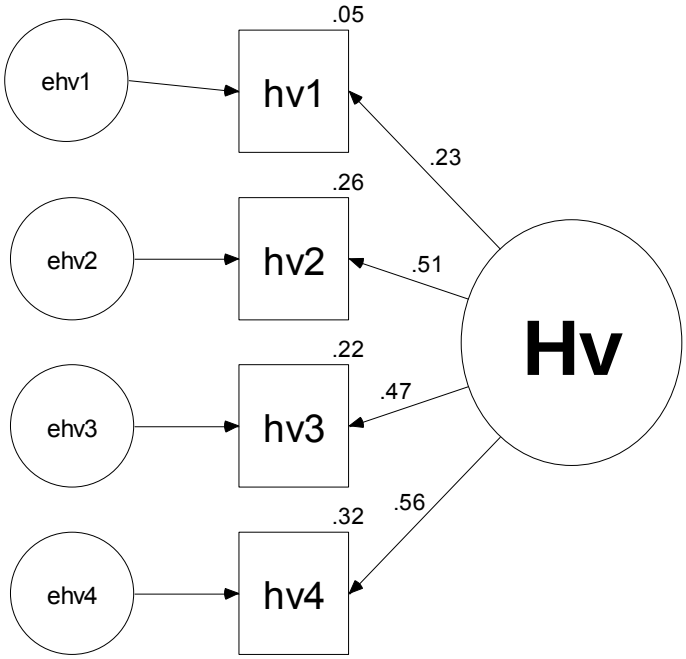

Figure 4.1. Measurement model for verbal ability.

The measurement model for verbal ability considered four manifested variables and their factor loading in verbal ability (HV). These 4 subescales are: Hv1,reading comprehension; Hv2, Analogies; Hv3, statement completion and Hv4, Anthonims.

Table 4.12. Regresion Weights Estimates of Verbal Ability

Regresión Weights						
			Estimate	S.E.	C.R.	P Label
hv4	<--	Hv	1.00000			

Table 4.12. Continued

hv3	<--	Hv	0.85291	0.09367	9.10551	0.00000
hv2	<--	Hv	0.93446	0.10300	9.07226	0.00000
hv1	<--	Hv	0.34955	0.05710	6.12203	0.00000

Note: Significant factor loading are the values with a critical ratio (C.R.) up to +-1.96

Once accomplished the normality assumptions and the outliers, the next matter was to see the factor weight of the measurement model. In table 4.12, the interest is centered in the critical ratio (c.r.) values. In the case of the measurement model, the four subscales weighed significantly in the factor HV, considering that their critical ratio values were above +-1.96 with a p = 0.01 (Byrne, 2001). So it can be claimed that HV is a common factor to the four subscales.

Table 4.13. Chi Square of Verbal Ability

Number of distinct sample moments = 10
Number of distinct parameters to be estimated = 8
Degrees of freedom = 10 - 8 = 2
Minimum was achieved
Chi-square = 6.900
Degrees of freedom = 2
Probability level = 0.032

Table 4.13 focuses on the probability level. The goodnes of fit value in SEM reported in this table the resuls of the chi-square Thes values should be considered in a wider context of goodness of fit criteria. Although chi square is always present among goodness of fit criteria, its interpretation is always contextual. The main reason of this is that this criterion has always resulted very dependent to other factors. There is also a consensus in the literature that this

parameter is sensitive to the differences in the sample size, particularly in large sample sizes, as in this case (Joreskog y Sorbom, 1993). The same situation applies for the probability level, that in this case is 0.032, which is significative at p=0.05. Considered isolated, it is determined that there are significant differences between the measurement model specified and the data. Nevertheless, this parameter required to be considered in the context of other goodness of fit criteria for conclusions to be established. The specialized literature agrees that chi-square has resulted to be little realistic.

In table 4.14, the complementary criteria for adjusted chi-square are shown (CMINDF). For the case of the verbal ability factor, the adjusted Chi square CMINDF reported a value of 3.45, which indicated a significative difference between the model and the data, considering the criterion of values > to 3.1. The RMR reported 0.04, which is interpreted as value barely acceptable, if considering the criterion of acceptable values those that are < 0.05 as a limit to establish that there is no significative difference between de data and the model.

The Goodnes of Fit Index (GFI) reported a value of 0.99 and it is interpreted as a good index because it is over 0.95. This is the same case for AGFI; that is an adjusted GFI. It reported a value of 0.98, and it is good because is over 0.90. The normed fit index reported 0.98 over the acceptable level of 0.90 and the Tucker Lewis Index reported 0.95, over the acceptable level of 0.90.

Another important index is the analysis of residuals RMSEA that reports a good value of 0.03. The criterion established that values of 0.06 or less are acceptable. Finally, the last values reported were the Hoelter indices that reached

a 1398 with a p=0.05 and 2150 with a p=0.01 respectively and were considered good values because they are over 200. These results are exposed on table 4.14

Table 4.14. Goodnes of Fit Estimates for the Sub-scale of Verbal Abilities

Fit Measures					
Fit Measure	Default model	Saturated	Independence	Macro	Criterio
Discrepancy	6.90004	0.00000	357.77333	CMIN	Menor Xi2
Degrees of freedom	2	0	6	DF	Mayor
P	0.03174		0.00000	P	0.01 y 0.05
Number of parameters	8	10	4	NPAR	Overidentified
Discrepancy / df	3.45002		59.62889	CMIN DF	b:< 2.1 m: 2.1 y 3.1
RMR	0.04930	0.00000	0.53618	RMR	< 0.05 o menos
GFI	0.99790	1.0000	0.88720	GFI	0-1 m:90-95 b: 95
Adjusted GFI	0.98949		0.81201	AGFI	0-1 acep: .90
Parsimony-adjusted GFI	0.19958		0.53232	PGFI	0-1 no aplica
Normed fit index	0.98071	1.0000	0.00000	NFI	0-1 .90
Relative fit index	0.94214		0.00000	RFI	0-1
Incremental fit index	0.98623	1.0000	0.00000	IFI	0-1
Tucker-Lewis index	0.95821		0.00000	TLI	0-1 acep: .90
Comparative fit index	0.98607	1.0000	0.00000	CFI	0-1
Parsimony ratio	0.33333	0.0000	1.00000	PRATIO	
Parsimony-adjusted NFI	0.32690	0.0000	0.00000	PNFI	no aplica
Parsimony-adjusted CFI	0.32869	0.0000	0.00000	PCFI	0-1
Noncentrality parameter estimate	4.90004	0.0000	351.77333	NCP	Rangos no aplica
NCP lower bound	0.31590	0.0000	293.46770	NCPLO	

Table 4.14. Continued

NCP upper bound	16.96064	0.0000	417.48875	NCPHI	
FMIN	0.00429	0.0000	0.22222	FMIN	
F0	0.00304	0.0000	0.21849	F0	Rangos
F0 lower bound	0.00020	0.0000	0.18228	F0LO	
F0 upper bound	0.01053	0.0000	0.25931	F0HI	
RMSEA	0.03901		0.19083	RMSEA	< 0.06 o menos
RMSEA upper bound	0.07258		0.20789	RMSEAHI	
P for test of close fit	0.65470		0.00000	PCLOSE	
Akaike information criterion (AIC)	22.90004	20.00000	365.77333	AIC	Cerca del cero no aplica
Browne-Cudeck criterion	22.94989	20.06231	365.79826	BCC	
Bayes information criterion	77.06728	87.70905	392.85695	BIC	
Consistent AIC	73.97692	83.84610	391.31177	CAIC	
Expected cross validation index	0.01422	0.01242	0.22719	ECVI	Rangos no aplica
ECVI lower bound	0.01138	0.01242	0.19097	ECVILO	
ECVI upper bound	0.02171	0.01242	0.26801	ECVIHI	
MECVI	0.01425	0.01246	0.22720	MECVI	no aplica
Hoelter .05 index	1398		57	HFIVE	Arriba de 200
Hoelter .01 index	2150		76	HONE	Arriba de 200

Note: The limit criteria is exposed in the last column to the right.

CMINDF should be used to evaluate significant differences between the model and the data, while RMR, GFI. AGFI, NFI, TLI , RMSEA and Hoelter values are important for the failing or acceptance of the hypotheses. To this moment, the verbal ability model adjusts to the data.

4.3.2 The Mathematics Ability Measurement Model

Next, the measurement model of mathematics ability its evaluated. The first reference is the multivariate normality evaluation.

Table 4.15. Multivariate Normality Evaluation for Mathematics Ability

Multivariate Normality						
	Min	Max	Skew	c.r.	kurtosis	c.r.
Mt1	0.0000	3.00000	0.70682	11.58561	-0.2426	-1.988
Mt2	0.0000	3.00000	0.71764	11.76281	-0.2536	-2.078
Mt3	0.0000	3.00000	0.67678	11.09318	-0.5067	-4.153
Mt4	0.0000	3.00000	0.52825	8.65862	-0.5444	-4.462
Mt5	0.0000	3.00000	0.82625	13.54308	0.1048	0.859
Mt6	0.0000	3.00000	1.04903	17.19466	0.3397	2.784
Mt7	0.0000	3.00000	0.61358	10.05716	-0.4637	-3.800
Mt8	0.0000	3.00000	0.74214	12.16439	-0.1992	-1.632
Multivariate				Mardia coeficient =	-2.1966	-3.486

Table 4.15 above shows a Mardia coeficient value of -2.19664, which is inside the rank +- 1 +- 10 . Consequently, the matematics abilities subscales reaches multivariate normality.

In table 4.16 the value 0.002 in the case 1258 shows that the Mahalanobis distance adjusted in the first trial and consequently reached the best value for the Mardia's coefficient. This data conffims the former conclusions about the mathematics abilities subscale.

Table 4.16. Mahalanobis Distance for Mathematics Abilities

Higher scores of Mahalanobis distance			
Observation Number	Mahalanobis d-squared	p1	p2
1258	24.21499	0.00211	0.96674
1312	23.75735	0.00252	0.91276
1124	23.15585	0.00317	0.88468
1423	22.57296	0.00396	0.88014

Note: Outliers= p1< to 0.001

The measurement model of mathematics abilities considered 8 observed variables representing the factor MT. These variables are Mt1, Statement comprehension; Mt2, Capacity to establish logic inferences; Mt3, Capacity to perform generalizations; Mt4, Capacity to reflexive abtraction; Mt5, Capacity to establish relationships; Mt6, Capacity to compare relationships; Mt7, Simbolization capacity and Mt8, Imagination Capacity.

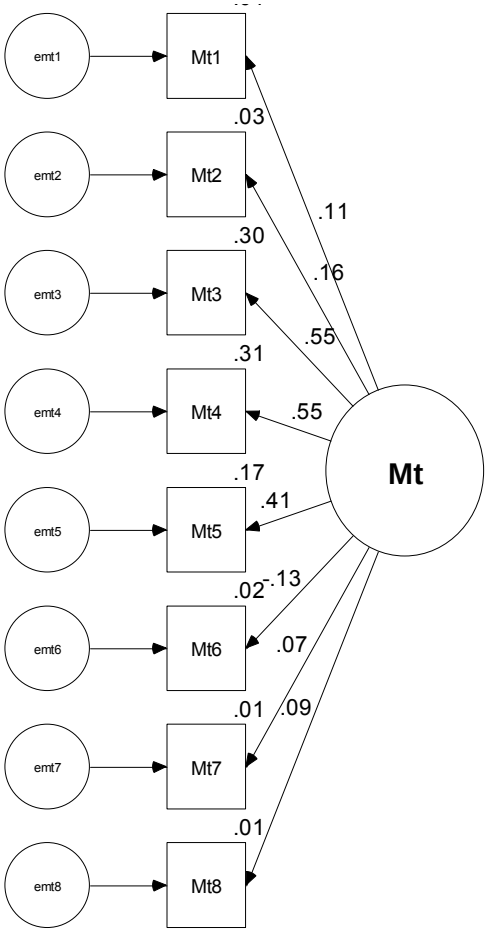

Figure 4.2. Measurement model of mathematics abilities

In the next lines, the results of the factor loadings distribution between the component mathematical abilities and its sub-scales will be analyzed.

Table 4.17. Factor Weights for Mathematics Abilities

Regression Weights							
			Estimate	S.E.	C.R.	P	Label
Mt8	<--	Mt	1.00000				
Mt7	<--	Mt	0.78761	0.47507	1.75790	0.09734	par-1
Mt6	<--	Mt	-1.35277	0.61261	-2.20819	0.02723	par-2
Mt5	<--	Mt	4.97620	1.90728	2.60905	0.00908	par-3
Mt4	<--	Mt	7.56106	2.91187	2.59663	0.00941	par-4
Mt3	<--	Mt	8.21316	3.13149	2.62277	0.00872	par-5
Mt2	<--	Mt	2.08129	0.87773	2.37122	0.01773	par-6
Mt1	<--	Mt	1.37019	0.66760	2.05240	0.04013	par-7

Note: Significant factor weights are those estimates up to 1.96 (C.R.)

Table 4.17 shows the factor loadings of the variable MT. The critical ratio of Mt7 reported a value of 1.757 which is under the accepted value of 1.96; and Mt6 has a negative value of -2.20 which is very irregular in factor loading. The rest of the values adjusted over the accepted level.This way, the subscales Mt1, Mt2, Mt3, Mt4, Mt5 y Mt8 are significantly represented by the factor mathematics abilities (MT).

Table 4.18 below reported a value of 0.073 as probability level. This value is above the required level of 0.05. Therefore, considering this as a isolated value, we can interpret that there are no significant differences between the measurement model and the data. Nevertheless, as the case above the contextualization of this value is required in contrats to other goodness of fit indices, for any conclusions to be established.

Table 4.18. Chi Square for Mathematics Abilities

Computation of degrees of freedom

Table 4.18 Continued

Number of distinct sample moments = 36
Number of distinct parameters to be estimated = 16
Degrees of freedom = 36 – 16 = 20
Minimum was achieved
Chi-square = 29.784
Degrees of freedom = 20
Probability level = 0.073

Table 4.19 reported a set of goodness of fit measures for this same model. The first of this is the chi square value (CMIN), which reports a value of 29.78 and is significant to 0.73, which is above of the 0.05 probability level. Consecuently, it is interpreted that it fails to reject the hypothesis that there is not a difference between the model and the data. The CMINDF supports the former interpretation reporting a value of 1.48, because it is inside the rank to be considered a good fit (< 2.1).

The RMR, with a 0.01 also reported a good adjustment fit (0.05 or less). GFI (0.99), AGFI (0.99), NFI (0.91) and TLI (0.96) also reported acceptable goodnes of fit values as they are all above the acceptable levels : 0.95, 0.90, 0.90 and 0.90 respectively. Finally, RMSEA reported a value of 0.01 which is considered acceptable as it is under the value of 0.06 and Hoelter indices reported values of 1698 and 2031 are over 2000 and were considerd good fit values.

Table 4.19. Goodnes of Fit Measures for Mathematics Abilities

Fit Measures					
Fit Measure	Default model	Saturated	Independence	Macro	Criterion
Discrepancy	29.78444	0.00000	371.84211	CMIN	low Xi2
Degrees of freedom	20	0	28	DF	Mayor
P	0.07342		0.00000	P	0.01 y 0.05

4.19. Continued

Number of parameters	16	36	8	NPAR	Overidentifie d
Discrepancy / df	1.48922		13.28008	CMINDF	b:< 2.1 m: 2.1 y 3.1
RMR	0.01091	0.00000	0.06016	RMR	< 0.05 o menos
GFI	0.99541	1.00000	0.93817	GFI	0-1 m:90-95 b: 95
Adjusted GFI	0.99175		0.92051	AGFI	0-1 acep: .90
Parsimony-adjusted GFI	0.55301		0.72969	PGFI	0-1 no aplica
Normed fit index	0.91990	1.00000	0.00000	NFI	0-1 .90
Relative fit index	0.88786		0.00000	RFI	0-1
Incremental fit index	0.97219	1.00000	0.00000	IFI	0-1
Tucker-Lewis index	0.96016		0.00000	TLI	0-1 acep: .90
Comparative fit index	0.97154	1.00000	0.00000	CFI	0-1
Parsimony ratio	0.71429	0.00000	1.00000	PRATIO	
Parsimony-adjusted NFI	0.65707	0.00000	0.00000	PNFI	no aplica
Parsimony-adjusted CFI	0.69396	0.00000	0.00000	PCFI	0-1
Noncentrality parameter estimate	9.78444	0.00000	343.84211	NCP	Rangos no aplica
NCP lower bound	0.00000	0.00000	285.28892	NCPLO	
bound					
NCP upper bound	28.5278 7	0.00000	409.84142	NCPHI	
FMIN	0.01850	0.00000	0.23096	FMIN	
F0	0.00608	0.00000	0.21357	F0	Rangos
F0 lower bound	0.00000	0.00000	0.17720	F0LO	
F0 upper bound	0.01772	0.00000	0.25456	F0HI	

4.19. Continued

RMSEA	0.01743		0.08733	RMSEA	< 0.06 o menos
RMSEA lower bound	0.00000		0.07955	RMSEALO	
RMSEA upper bound	0.02977		0.09535	RMSEAHI	
P for test of close fit	1.00000		0.00002	PCLOSE	
Akaike information criterion (AIC)	61.78444	72.00000	387.84211	AIC	Cerca del cero no aplica
Browne-Cudeck criterion	61.96433	72.40475	387.93206	BCC	
Bayes information criterion	181.20927	340.70587	447.55453	BIC	
Consistent AIC	163.93821	301.84597	438.91900	CAIC	
Expected cross validation index	0.03838	0.04472	0.24090	ECVI	Rangos no aplica
ECVI lower bound	0.03230	0.04472	0.20453	ECVILO	
ECVI upper bound	0.05002	0.04472	0.28189	ECVIHI	
MECVI	0.03849	0.04497	0.24095	MECVI	no aplica
Hoelter .05 index	1698		179	HFIVE	Arriba de 200
Hoelter .01 index	2031		210	HONE	Arriba de 200

As appreciated, all these estimates of goodness of fit, even the chi square, favor the interpretation of failing to reject the nil hypothesis and consequently there are no differences between the measurement model and the data. It is affirmed, then, that the measurement model of mathematics abilities fit the sample data.

4.3.3 Formal Reasoning Subscale

Table 4.20 bellow shows the Mardia's coeficient value (3.34), which can be considered inside the rank of 1 to 10. Consequently, it is affirmed that the sample has a multivariate normal distribution.

Table 4.20. Multivariate Normality Evaluation of Formal Reasoning

Evaluacion de normalidad						
	Min	Max	Skew	c.r.	Kurtosis	c.r.
rf1	0.00000	4.00000	1.20539	19.75758	1.5228	12.48015
rf2	0.00000	4.00000	0.59352	9.72837	-0.1686	-1.38196
rf3	0.00000	4.00000	0.84785	13.89713	-0.2049	-1.67995
rf4	0.00000	4.00000	0.74306	12.17952	0.1430	1.17213
rf5	0.00000	4.00000	0.53664	8.79611	-0.3879	-3.17974
rf6	0.00000	4.00000	0.63072	10.33811	-0.3841	-3.14819
rf7	0.00000	4.00000	0.89515	14.67237	0.3783	3.10066
rf8	0.00000	4.00000	0.93140	15.26667	0.6493	5.32143
Multivariate				Mardia's Coefficient=	3.3466	5.31139

Mardia's coefficient in table 4.20 could have been improved erasing four cases reported by the Mahalanobis distance estimate in table 4.21 below. Nevertheless, the values obtained at this moment are good and this justify to keep these cases in the database.

Tabla 4.21. Mahalanobis Distance of Formal Reasoning

Higher scores of Mahalanobis distance			
Observation	Mahalanobis		
Number	d-squared	p1	p2
1605	33.33630	0.00005	0.08272
850	28.11742	0.00045	0.16604
1387	27.81239	0.00051	0.05092
1310	27.77779	0.00052	0.01049
916	26.10709	0.00101	0.02491
675	25.65294	0.00120	0.01446
1342	25.58035	0.00124	0.00447
1525	25.31603	0.00137	0.00204
1341	24.86939	0.00164	0.00162

Note: outliers= p1 <de 0.001.

The measurement model for formal reasoning (Rf) considered 8 observed variables as subscales. These are: Rf1, Compensaciones multiplicativas. Rf2, Pensamiento correlacional. Rf3, Pensamiento probabilístico. Rf4, Pensamiento combinacional. Rf5, Pensamiento proporcional. Rf6, Formas de conservación sin verificación directa. Rf7, Equilibrio mecánico. Rf8, Coordinación de dos o más sistemas de referencia.

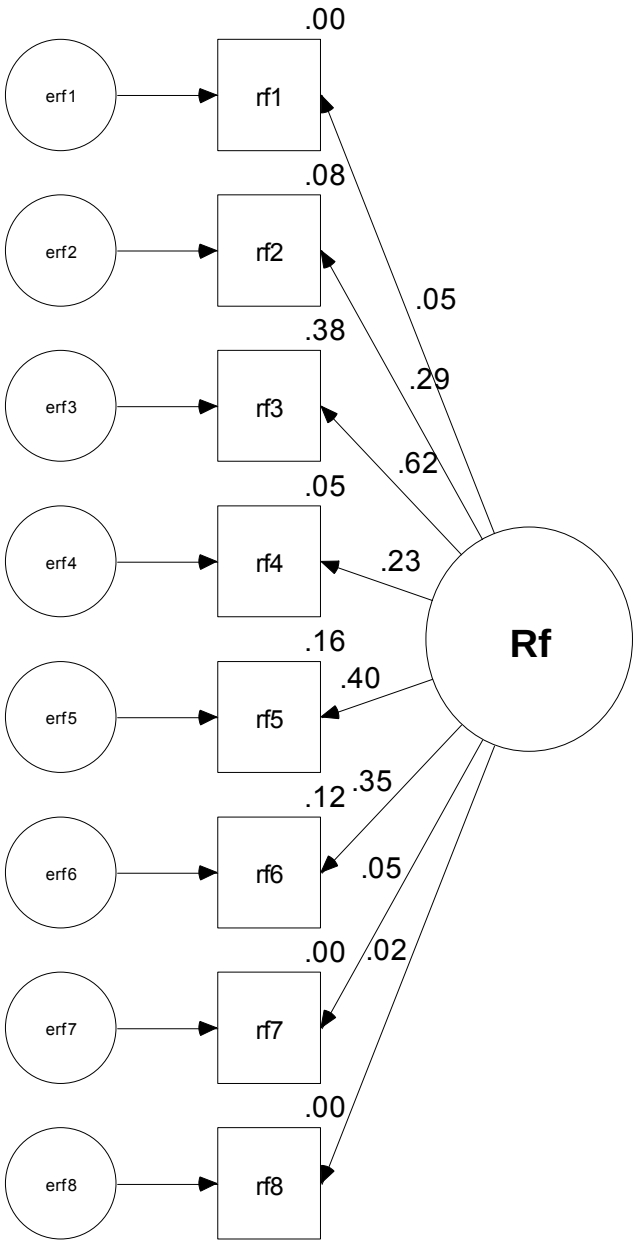

Figure 4.3. Measurment model of formal reasoning.

No cases were erased from the database in this case and the study proceeded to the factor weights analysis, as reccomended by the mahalanobis distance. Table 4.22 below shows the factor weight values of these subscales. Observing the critical ratio values, it is appreciated that none of the components of

formal reasoning (Rf) are charging the factor. In all these cases the critical ratio is under +- 1.96. These values will be considered for a re-specification of the model.

Table 4.22. Factor Weights of Formal Reasoning

Regression Weights							
			Estimate	S.E.	C.R.	P	Label
rf8	<--	Rf	1.00000				
rf7	<--	Rf	1.76460	2.28976	0.77065	0.44091	par-1
rf6	<--	Rf	11.41808	12.79659	0.89227	0.37225	par-2
rf5	<--	Rf	15.35537	17.19240	0.89315	0.37178	par-3
rf4	<--	Rf	7.43259	8.37093	0.88791	0.37459	par-4
rf3	<--	Rf	30.17191	33.78642	0.89302	0.37185	par-5
rf2	<--	Rf	9.45588	10.61679	0.89065	0.37312	par-6
rf1	<--	Rf	1.67476	2.17567	0.76977	0.44144	par-7

Note: C. R. up to 1.96= Significant factor weight values

Prior to proceed with the re-specification of the model, it is importan to analyze it from an exploratory or heuristic approach, in a way that the appreciations exposed can be validated. The heuristic used to test the results obtained so far involved the three sub-scales analyzed in an unitary model that explored the interrealtion of the sub-scales and between sub-scales. Their graphic representation is exposed below and it will allow to evaluate a key competences model that will be denominated as human capital measurement model.

4.3.4 The Heuristic Model

The heuristic model that tested the results exposed above included the 20 subscales (8 from Rf, 8 from Mt and 4 from Hv) in a single model (key competences) and visualizaed the three hypothetized factors and their relations with each proposed factor.

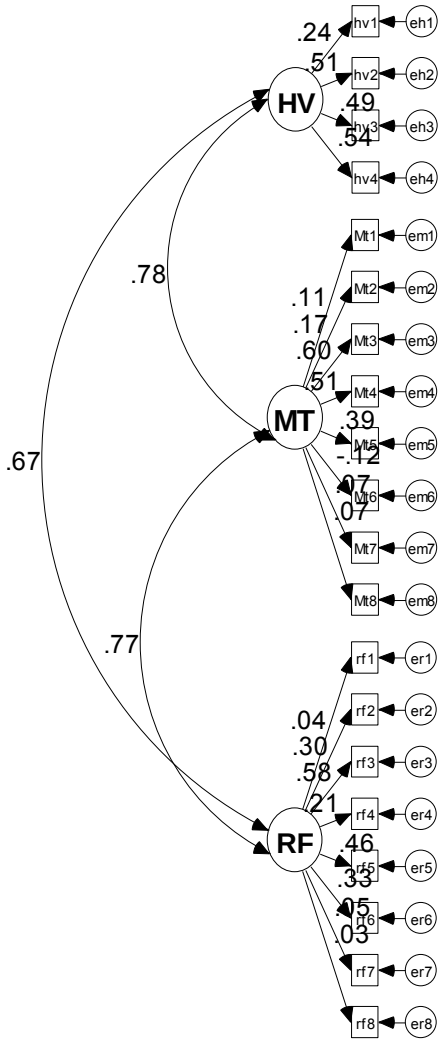

Figure 4.4. Heuristic model of the three key competences' sub scales.

Figure 4.4 proposes to analyze the inter-relation of each factor with the others. In that sense it is heuristic, as it allows to validate the appreciations found in the partial analysis of each factor.

To establish multi-variate normality, the Mardia coefficient will be analyzed again to see the difference in its result when the model is analyzed in a global way.

Table 4.23. Multivariate Normality for the Key Competences Model

Multivariate normality						
	Min	Max	Skew	c.r.	Kurtosis	c.r.
rf8	0.00000	4.00000	0.93140	15.26667	0.64931	5.3214
rf7	0.00000	4.00000	0.89515	14.67237	0.37834	3.1006
rf6	0.00000	4.00000	0.63072	10.33811	-0.38413	-3.1481
rf5	0.00000	4.00000	0.53664	8.79611	-0.38798	-3.1797
rf4	0.00000	4.00000	0.74306	12.17952	0.14302	1.1721
rf3	0.00000	4.00000	0.84785	13.89713	-0.20498	-1.6799
rf2	0.00000	4.00000	0.59352	9.72837	-0.16862	-1.3819
rf1	0.00000	4.00000	1.20539	19.75758	1.52280	12.480
Mt8	0.00000	3.00000	0.74214	12.16439	-0.19924	-1.6328
Mt7	0.00000	3.00000	0.61358	10.05716	-0.46379	-3.8009
Mt6	0.00000	3.00000	1.04903	17.19466	0.33978	2.7846
Mt5	0.00000	3.00000	0.82625	13.54308	0.10489	0.8596
Mt4	0.00000	3.00000	0.52825	8.65862	-0.54448	-4.4622
Mt3	0.00000	3.00000	0.67678	11.09318	-0.50677	-4.1532
Mt2	0.00000	3.00000	0.71764	11.76281	-0.25364	-2.0786
Mt1	0.00000	3.00000	0.70682	11.58561	-0.24269	-1.9889
hv4	0.00000	10.00000	0.60120	9.85437	0.10292	0.8434
hv3	0.00000	10.00000	0.58877	9.65053	0.17283	1.4164
hv2	0.00000	11.00000	0.79846	13.08757	0.83765	6.8650
hv1	0.00000	9.00000	0.39754	6.51609	0.02279	0.1867
Multivariate				Mardia Coeficient=	7.09397	4.8006

Table 4.23 considers the three components in a single model without a pre-determined dispossition of the sub-scales. In this sense, this is an exploratory or heuristic model and its purpose is to make evident the failings of the model in different aspects. Table 4.23 shows the multi-variate normality evauation. In this case, the Mardia coeficient (7.09) is in the top level of the rank (1- 10) at a point closer to 10 than 1. For practical ends, this value is significant to establish multivariate normality.

Table 4.24 Mahalanobis Distance Key Competences Model

Higher scores of Mahalanobis distance			
Observation	Mahalanobis		
Number	d-squared	p1	p2
708	52.40636	0.00010	0.14795
1172	50.92238	0.00016	0.02908
1590	50.56496	0.00018	0.00347
850	50.54599	0.00018	0.00026
916	50.39221	0.00019	0.00002
1286	49.43514	0.00027	0.00001
1605	47.74205	0.00046	0.00001
1540	43.52100	0.00174	0.00825
1185	42.74856	0.00221	0.00033

Note: Outliers= p1 < 0.001.

Table 4.24 did not adjust the p1 for the first 7 cases with a mahalanobis distance below 0.001. This interpreatation, confronted to a normal Mardia coefficient, justifies a more careful approach to the evaluation of the model, regardless the fact that it is near to the limits.

In the other hand, Table 4.25 reported a global appreciation of the model: all the sub-scales of verbal abilities load the factor Hv; the subscales of mathematics abilities, except for mt6 and mt7, load the factor Mt; and the subscales of formal reasoning do not load the factor Rf.

Table 4.25. Factor Weights of Heuristic Models

Regression Weights							
			Estimate	S.E.	C.R.	P	Label
hv1	<--	HV	1.00000				
hv2	<--	HV	2.64357	0.37478	7.05370	0.00000	
hv3	<--	HV	2.50993	0.35773	7.01631	0.00000	
hv4	<--	HV	2.70796	0.38017	7.12305	0.00000	
Mt1	<--	MT	1.00000				
Mt2	<--	MT	1.62452	0.52507	3.09389	0.00198	
Mt3	<--	MT	6.73348	1.84982	3.64007	0.00027	
Mt4	<--	MT	5.23497	1.44593	3.62049	0.00029	

Table 4.25. Continued

Mt5	<--	MT	3.54057	0.99357	3.56350	0.00037	
Mt6	<--	MT	-0.93462	0.34472	-2.71121	0.00670	
Mt7	<--	MT	0.54183	0.28751	1.88457	0.05949	
Mt8	<--	MT	0.60293	0.29649	2.03352	0.04200	
Rf1	<--	RF	1.00000				
Rf2	<--	RF	7.64028	6.05575	1.26166	0.20707	
Rf3	<--	RF	21.81079	17.18004	1.26954	0.20425	
rf4	<--	RF	5.38392	4.30186	1.25153	0.21074	
rf5	<--	RF	13.41518	10.57907	1.26809	0.20477	
rf6	<--	RF	8.35713	6.61368	1.26361	0.20637	
rf7	<--	RF	1.40388	1.37705	1.01949	0.30797	
rf8	<--	RF	0.71740	0.96906	0.74030	0.45912	

Note: Significant factor weights = C.R. up1.96

This can be appreciated by examining the critical ratio column, considering the > 1.96 as a critical value to establish a significant factor loading. This result demands a re-specification of the model that allows to achieve that the key competences measurement model load factors as a pre-requisite to consider it's inclusion on a structural model. The verbal skill factor can be reprised intact in the re-specification of the new human capital model. The matemathical abilities can be reprised partially, conditioned to the exclusion of two sub-scales in the new model, which are Mt6 and Mt7. Finally, the formal reasoining sub-scales must be excluded in the new model.

The measuring model for the dependant variable consider a traditional option, analyzed in the descriptive exposure, entitled GPA; and a second choice of adjusted dependant variable, that in this case is of a factorial nature. It includes the sub-scales of each of the six courses of first semester: Engish; information and communication technologies; reading and oral and written expression; chemistry; science, technology, society and values and algebra.

4.3.5 The Dependent Factorial Variable

The dependent factorial is the result of considering the variablility in the six courses of the students in their first semester. The ellements that compound this variable are the grades obtained in those six courses, but the resource to represent them is not the central tendency, as it happens with GPA; but a variability measure, in this case of a factorial nature.

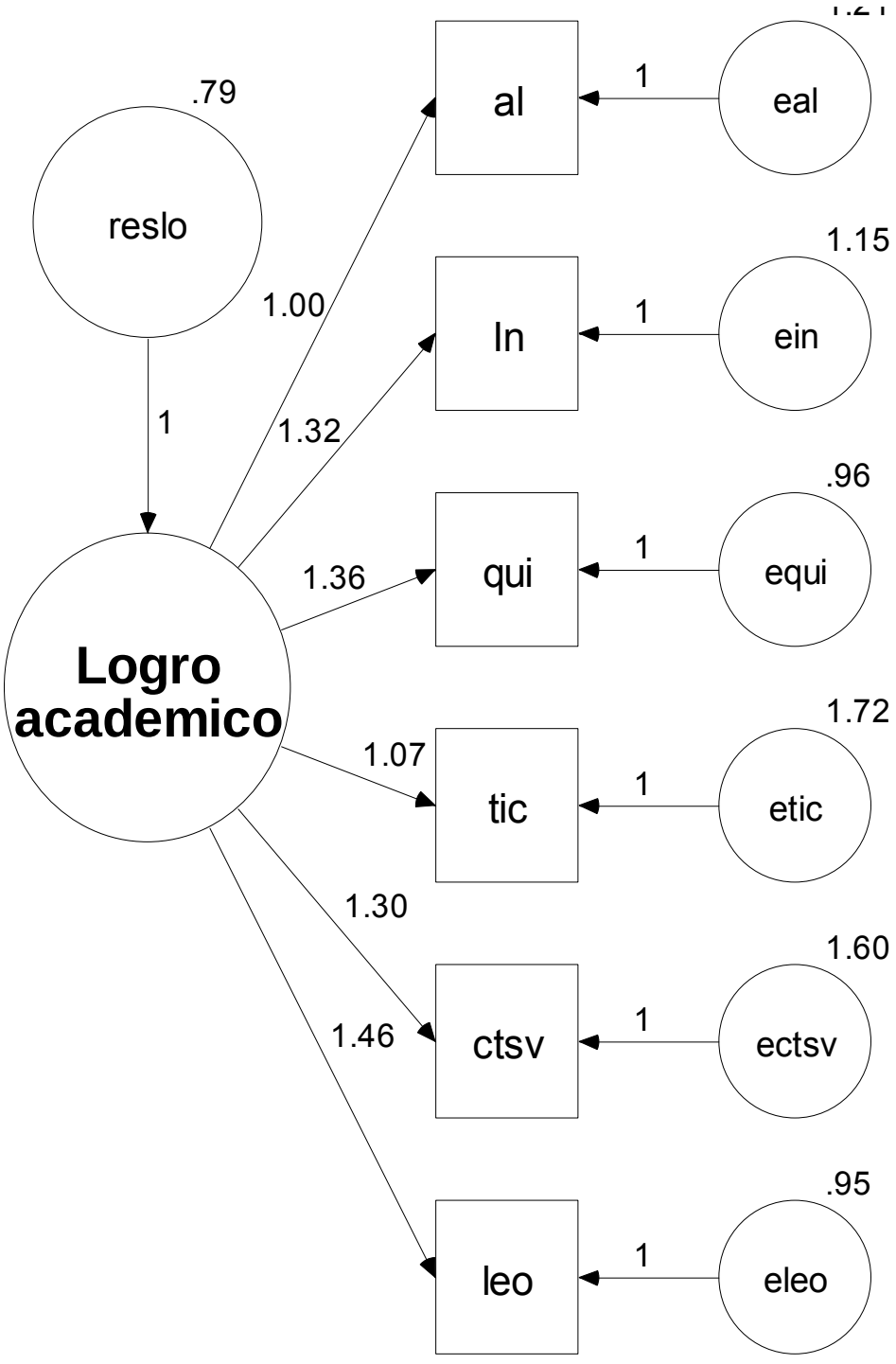

Figure 4.5. Measurement model of the factorial dependent variable

Table 4.26. Multivariate Normality Evaluation of the Endogenous Latent Variable

Normality evaluation						
	Min	Max	Skew	c.r.	Kurtosis	c.r.
Leo	5.00000	10.00000	0.11050	1.81059	-1.16318	-9.5299
Ctsv	5.00000	10.00000	-0.30781	-5.04380	-1.10583	-9.0600
Tic	5.00000	10.00000	-0.14398	-2.35925	-1.10764	-9.0748
Qui	5.00000	10.00000	0.10990	1.80083	-1.11473	-9.1329
In	5.00000	10.00000	0.22711	3.72148	-1.06255	-8.7055
Al	5.00000	10.00000	0.76718	12.57096	-0.43079	-3.5294
Multivariate				Mardia Coeficient	-1.78126	-3.6484

The multivariate normality evaluation of this model is showed in table 4.26 above. Mardia's coficient adjusted with a value -1.78 and therefore, it considers that the subscales are normally distributed from a multivariate angle.

Table 4.27. Mahalannobis's Distance of the Endogenous Latent Variable

Higher scores of Mahalanobis distance			
Observation	Mahalanobis		
Number	d-squared	p1	P2
935	21.96768	0.00123	0.86171
602	21.28077	0.00163	0.73881
354	19.79306	0.00301	0.86308
18	19.76668	0.00305	0.72234
442	19.14211	0.00393	0.75743

Mahalanobis's distance values ajusted in the first trial as seen in table 4.27 with a value of 0.001 and therefore the Mardia coefficient is already in its limits.

Table 4.28. Factor Weights of the Latent Endogenous Variable

Regression Weights							
			Estimate	S.E.	C.R.	P	Label
Al	<--	Logro_academico	1.00000				
In	<--	Logro_academico	1.31930	0.05556	23.74438	0.00000	
Qui	<--	Logro_academico	1.36102	0.05529	24.61533	0.00000	
Tic	<--	Logro_academico	1.06870	0.05368	19.90934	0.00000	
Cts.	<--	Logro_academico	1.29887	0.05842	22.23232	0.00000	
Leo	<--	Logro_academico	1.46476	0.05837	25.09536	0.00000	

Note: Significant factor weights= C.R. > 1.96.

Critical ratio values displayed in table 4.28, showed that all subscales of the latent factorial variable load this factor because they are up to +- 1.96. Consequently, they are represented by its factor academic achievement.

The report of goodness of fit measures in table 4.29 below, offered two interpretations. The parameter CMIN (chi square) reported 101.90 with a p = of 0.000. The CMINDF reported 11.32, whichs is a value above the limit value of 3.1. RMR reached a value of 0.07, which is above the limit of 0.05 and RMSEA obtained value was 0.08 also above the limit of 0.06. In this four cases it can be interpreted that there are no adjustment between the model and the data. In the other side, GFI (0.97), AGFI (0.94), NFI (0.97) and TLI (0.95) reached good fit values. Finally, Hoelter indices reached values of 268 and 343 also considered as good fit values as they are over 200. This allows to infere that the nil hypothesis cannot be rejected. Consequentlly, the model provisionally adjusts.

In the re-specification of the model, three aspects were considered. First, the verbal ability measure model is included intact. Second, the measuring model for mathematical skills is partially reprised, excluding the sub-scales that did not load the Hm factor (Mt6 and Mt7). Third, the eight sub-scales of the formal reasoning scales is eliminated. In the exploration of the model, the re-specification is considered an improve of the goodness of fit indices.

Table 4.29. Goodnes of Fit Measures of Endogenous Latent Variable

Fit Measures					
Fit Measure	Default model	Saturated	Independence	Macro	Criterio
Discrepancy	101.90229	0.00000	3730.83487	CMIN	Menor Xi2

Table 4.29. Continued

Degrees of freedom	9	0	15	DF	Mayor
P	0.00000		0.00000	P	0.01 y 0.05
Number of parameters	12	21	6	NPAR	Overidentified
Discrepancy / df	11.32248		248.72232	CMINDF	b:< 2.1 m: 2.1 y 3.1
RMR	0.07771	0.00000	1.06324	RMR	< 0.05 o menos
GFI	0.97726	1.00000	0.44795	GFI	0-1 m:90-95 b: 95
Adjusted GFI	0.94694		0.22713	AGFI	0-1 acep: .90
Parsimony-adjusted GFI	0.41883		0.31996	PGFI	0-1 no aplica
Normed fit index	0.97269	1.00000	0.00000	NFI	0-1 .90
Relative fit index	0.95448		0.00000	RFI	0-1
Incremental fit index	0.97504	1.00000	0.00000	IFI	0-1
Tucker-Lewis index	0.95833		0.00000	TLI	0-1 acep: .90
Comparative fit index	0.97500	1.00000	0.00000	CFI	0-1
Parsimony ratio	0.60000	0.00000	1.00000	PRATIO	
Parsimony-adjusted NFI	0.58361	0.00000	0.00000	PNFI	no aplica
Parsimony-adjusted CFI	0.58500	0.00000	0.00000	PCFI	0-1
Noncentrality parameter estimate	92.90229	0.00000	3715.83487	NCP	Rangos no aplica
NCP lower bound	64.08158	0.00000	3518.65778	NCPLO	
NCP upper bound	129.17930	0.00000	3920.28121	NCPHI	
FMIN	0.06329	0.00000	2.31729	FMIN	

Table 4.29 Continued

F0	0.05770	0.00000	2.30797	F0	Rangos
F0 lower bound	0.03980	0.00000	2.18550	F0LO	
F0 upper bound	0.08024	0.00000	2.43496	F0HI	
RMSEA	0.08007		0.39226	RMSEA	< 0.06 o menos
RMSEA lower bound	0.06650		0.38171	RMSEALO	
RMSEA upper bound	0.09442		0.40290	RMSEAHI	
P for test of close fit			0.00001	PCLOSE	
Akaike information criterion (AIC)		42.00000	3742.83487	AIC	Cerca del cero no aplica
Browne-Cudeck criterion		42.18341	3742.88727	BCC	
Bayes information criterion		192.70377	3785.89309	BIC	
Consistent AIC		176.07682	3781.14253	CAIC	
Expected cross validation index		0.02609	2.32474	ECVI	Rangos no aplica
ECVI lower bound		0.02609	2.20227	ECVILO	
ECVI upper bound		0.02609	2.45173	ECVIHI	
MECVI		0.02620	2.32477	MECVI	no aplica
Hoelter .05 index		268	11	HFIVE	Arriba de 200
Hoelter .01 index		343	14	HONE	Arriba de 200

Note: The limit criteria is exposed in the last column to the right.

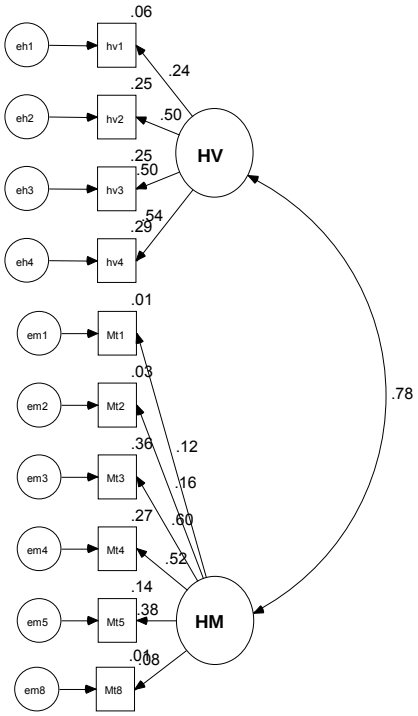

Figure 4.6. Re specification of the key competences model.

Table 4.30 shows a chi square value of 0.05 and a p of 0.11. This means that it fails to reject that the model adjusted to the data. Therefore, It must be accepted the nil hypothesis. Nevertheless, as establised before, other fit values will be considered to make a better decision

Table 4.30. Chi Square for the Re-specification of the Measurement Model of Key Competences.

Computation of degrees of freedom
Number of distinct sample moments = 55
Number of distinct parameters to be estimated = 21
Degrees of freedom = 55 - 21 = 34
Minimum was achieved
Chi-square = 44.029
Degrees of freedom = 34
Probability level = 0.116

Table 4.31 shows a Mardia's coeficient of 0.59, which is considered as and excellent value (Less than 1), so that the sample data has got multivariate normality.

Table 4.31. Multivariate Normality Evaluation. Measurement Model of Key Competences

	Min	max	Skew	c.r.	kurtosis	c.r.
Mt8	0.00000	3.00000	0.74306	12.17577	-0.19890	-1.62
Mt5	0.00000	3.00000	0.82833	13.57293	0.11244	0.92
Mt4	0.00000	3.00000	0.52746	8.64292	-0.54467	-4.46
Mt3	0.00000	3.00000	0.67860	11.11944	-0.50343	-4.12
Mt2	0.00000	3.00000	0.71799	11.76504	-0.25454	-2.08
Mt1	0.00000	3.00000	0.70859	11.61087	-0.23667	-1.93
hv4	0.00000	10.00000	0.60286	9.87838	0.10928	0.89
hv3	0.00000	10.00000	0.59026	9.67194	0.17498	1.43
hv2	0.00000	11.00000	0.80023	13.11261	0.84164	6.89
hv1	0.00000	9.00000	0.37462	6.13848	-0.05626	-0.46
Table 4.31 *Continue*						
Multivariate				Mardia Coeficient=	0.78638	1.01
Multivariate				Mardia Coeficient=	0.59883	0.77

Note: the limit value is Mardia's coefficient and it is located in the intersection between the kurtosis column and the multivariate row.

4.3.6 Respecification of the Key Competences Model

The re-specification of the new measure model of human capital includes integrally the component called verbal abilities; it recovers six of the eight sub-scales of mathematical abilities and eliminates the eight components of formal reasoning. This new model was tested and, as it is already evident, the difference between the heuristic model (7.0) and the re-specified model (0.59) is quite

significant. While the heuristic model was near to the rejection limits of normality, the re-specified model is within the excellent adjustment criterion.

The mahalanobis distance in table 4.32 required an adjustement in the 1184 value. After that, the test adjusted to 0.001

Table 4.32. Mahalanobis Distance for Key Competences

Puntajes mas alejados del centroide (Mahalanobis distance)			
Observation	Mahalanobis		
Number	d-squared	P1	p2
1184	30.95480	0.00060	0.61783
1542	28.55681	0.00147	0.68453
1394	27.68704	0.00203	0.63340
642	27.04807	0.00256	0.59041
1281	26.19847	0.00348	0.65977

As it can be appreciated in table 4.33, shown below, in the critical ratio column, the re-specified model of key competences loads now in all its components. Analyzing the critical ratio column, it can be appreciated that the four components of verbal ability, as the six components of mathematical abilities, load each in their respective facto: Hv and Hm. IN the case of Mt8, the factor barely loads in the limit of the established criterion, which allows to include it as a significant load of the Mt factor.

Tabla 4.33. Factor Loadings Including Mt8

Regression Weights							
			Estimate	S.E.	C.R.	P	Label
hv1	<--	HV	1.00000				
hv2	<--	HV	2.66485	0.39192	6.79954	0.0000	par-1
hv3	<--	HV	2.58576	0.38084	6.78960	0.0000	par-2
hv4	<--	HV	2.70814	0.39492	6.85736	0.0000	par-3
Mt1	<--	MT	1.00000				
Mt2	<--	MT	1.50017	0.50999	2.94154	0.0032	par-4
Mt3	<--	MT	6.60985	1.86576	3.54271	0.0004	par-5
Mt4	<--	MT	5.25626	1.48878	3.53059	0.0004	par-6

Tabla 4.33. Continued

Mt5	<--	MT	3.38537	0.97702	3.46500	0.0005	par-7
Mt8	<--	MT	0.60497	0.30420	1.98869	0.0467	par-8

Another re-specification was held in the exclusion of Mt8. The table 4.34 evaluates the normality of the model without Mt8. The Mardia's coefficient reaches up to 0.97.

Table 4.34. Normality Evaluation for the New Human Capital Model.

Multivariate normality						
	Min	Max	Skew	c.r.	kurtosis	c.r.
Mt5	0.00000	3.00000	0.83041	13.60284	0.12003	0.98
Mt4	0.00000	3.00000	0.52918	8.66840	-0.54134	-4.43
Mt3	0.00000	3.00000	0.67852	11.11468	-0.50485	-4.13
Mt2	0.00000	3.00000	0.71835	11.76728	-0.25544	-2.09
Mt1	0.00000	3.00000	0.70220	11.50273	-0.25638	-2.09
hv4	0.00000	10.00000	0.59285	9.71141	0.08168	0.66
hv3	0.00000	10.00000	0.58978	9.66105	0.17288	1.41
hv2	0.00000	11.00000	0.79994	13.10371	0.83921	6.87
hv1	0.00000	9.00000	0.37616	6.16187	-0.05269	-0.43
Multivariate				Mardia coeficient =	0.97922	1.39

The new model of human capital reported, in table 4.34, a value of 0.97. Since this value is under 1, it must be interpreted as a very good fit and therefore, the new model is provisionally normal from a multivariate approach. It is noted that the new model gained normality with the re-specification.

Table 4.35. Factor Weight for the Key Competences New Model

Regression Weights							
			Estimate	S.E.	C.R.	P	Label
hv1	<--	HV	1.00000				
hv2	<--	HV	2.66951	0.39348	6.78441	0.000	par-1
hv3	<--	HV	2.58795	0.38207	6.77354	0.000	par-2
hv4	<--	HV	2.72480	0.39803	6.84570	0.000	par-3
Mt1	<--	MT	1.00000				
Mt2	<--	MT	1.45741	0.49307	2.95577	0.003	par-4

Tabla 4.35. Continued

Mt3	←	MT	6.49953	1.80883	3.59322	0.000	par-5
Mt4	←	MT	5.17871	1.44624	3.58081	0.000	par-6
Mt5	←	MT	3.32619	0.94718	3.51169	0.000	par-7

As appreciated in table 4.35, the new measurement model of key competences showed critical ratio values > =_1.96 in all of its components. It is interpreted that the subscales loaded the two involved factor (Hm and Hv) with no exceptions in this case. This condition of re-specified model with all its components loaded, permitted to evaluate a wider group of goodness of fit measures as we proceed. It was important to achieve this adjustment before evaluatng this human capital measurement model within a structural model.

Table 4.36 shows the estimated parameters of goodness of fit for the measurement model of the exogenous variable.

Table 4.36. Goodness of fit for the Human Capital Model

Fit Measures					
Fit Measure	Default model	Saturated	Independence	Macro	Criterio
Discrepancy	31.59948	0.00000	998.26626	CMIN	Menor Xi2
Negrees of freedom	26	0	36	DF	Mayor
P	0.20670		0.00000	P	0.01 y 0.05
Number of parameters	19	45	9	NPAR	Overidentified
Discrepancy / df	1.21536		27.72962	CMINDF	b:< 2.1 m: 2.1 y 3.1
RMR	0.03347	0.00000	0.30150	RMR	< 0.05 o menos
GFI	0.99568	1.00000	0.83326	GFI	0-1 m:90-95 b: 95
Adjusted GFI	0.99252		0.79157	AGFI	0-1 acep: .90
Parsimony-adjusted GFI	0.57528		0.66661	PGFI	0-1 no aplica

Table 4.36. Continued

Normed fit index	0.96835	1.00000	0.00000	NFI	0-1 .90
Relative fit index	0.95617		0.00000	RFI	0-1
Incremental fit index	0.99424	1.00000	0.00000	IFI	0-1
Tucker-Lewis index	0.99194		0.00000	TLI	0-1 acep: .90
Comparative fit index	0.99418	1.00000	0.00000	CFI	0-1
Parsimony ratio	0.72222	0.00000	1.00000	PRATIO	
Parsimony-adjusted NFI	0.69936	0.00000	0.00000	PNFI	no aplica
Parsimony-adjusted CFI	0.71802	0.00000	0.00000	PCFI	0-1
Noncentrality parameter estimate	5.59948	0.00000	962.26626	NCP	Rangos no aplica
NCP lower bound	0.00000	0.00000	862.92858	NCPLO	
NCP upper bound	23.98891	0.00000	1069.00388	NCPHI	
FMIN	0.01964	0.00000	0.62043	FMIN	
F0	0.00348	0.00000	0.59805	F0	Rangos
F0 lower bound	0.00000	0.00000	0.53631	F0LO	
F0 upper bound	0.01491	0.00000	0.66439	F0HI	
RMSEA	0.01157		0.12889	RMSEA	< 0.06 o menos
RMSEA lower bound	0.00000		0.12206	RMSEALO	
RMSEA upper bound	0.02395		0.13585	RMSEAHI	
P for test of close fit	1.00000		0.00002	PCLOSE	
Akaike information criterion (AIC)	69.59948	90.00000	1016.26626	AIC	Cerca del cero no aplica

Table 4.36. Continued

Browne-Cudeck criterion	69.83713	90.56285	1016.37883	BCC	
Bayes information criterion	213.64254	431.15463	1084.49718	BIC	
Consistent AIC	190.89528	377.27953	1073.72216	CAIC	
Expected cross validation index	0.04326	0.05594	0.63161	ECVI	Rangos no aplica
ECVI lower bound	0.03978	0.05594	0.56987	ECVILO	
ECVI upper bound	0.05469	0.05594	0.69795	ECVIHI	
MECVI	0.04340	0.05629	0.63168	MECVI	no aplica
Hoelter .05 index	1980		83	HFIVE	Arriba de 200
Hoelter .01	2325		95	HONE	Arriba de 200

In general terms the independent variable for this model showed excellent goodness of fit values. For example, the CMIN, or chi square, reached a 31.59 value and a p = 0.20. This means that the model adjusts above the 0.05. There are no differences between the data and the model. Consequently. It failed to reject the nil hypothesis.

Other estimated values sustained this affirmation. CMIN/DF reported a value of 1.2 (below 2,1), RMR, 0.03, (under 0.05), GFI, 0.99 (over 0.95), Ajusted GF, 0.99 value (over 0.90), NFI, 0.96 value (over 0.90), TLI, 0.99 value(over 0.90), RMSEA 0.01(under 0.06) and finally, Hoelter values of 1980 and 2325 (over 200). In all the cases, including Chi square, all the indices harmonized in the same interpretation. The goodness of fit measures established that it failed to reject the

nil hypothesis and therefore there is no significant difference between the model and the data.

4.4 Results of the Analysis of the Structural Model

In this section the results of the analysis of the structural model will be displayed.

4.4.1 Structural Model with Manifest Dependent

The next figure shows the structural model with the variation of manifest dependent.

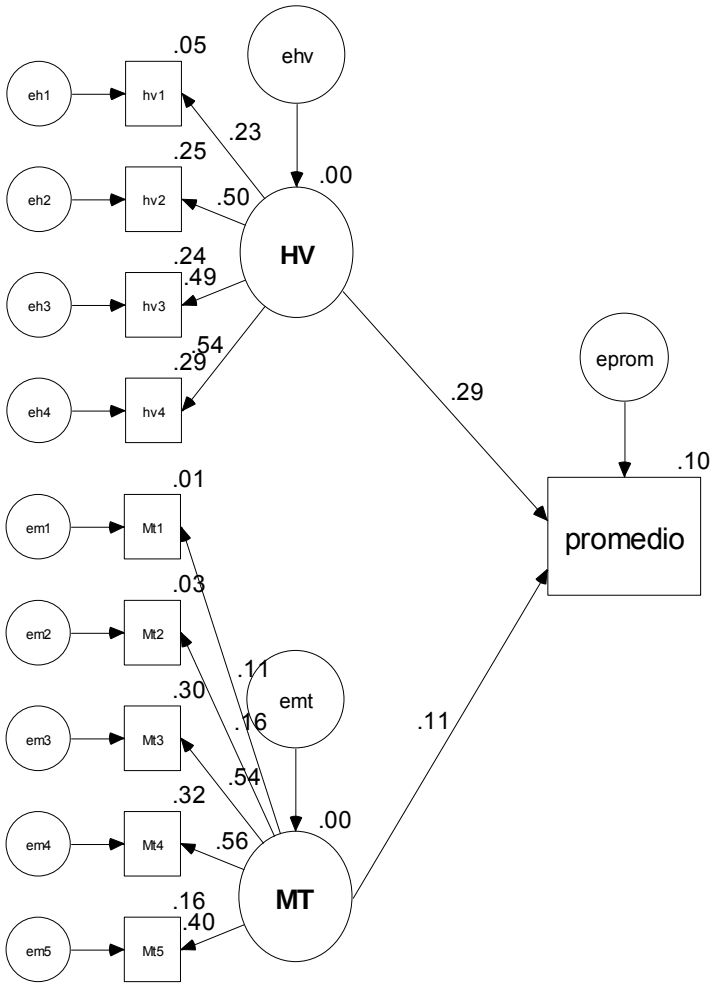

Figure 4.7. Structural model with an observed endogenous variable

Figure 4.7 shows the measurement model for the independent variable, after it was re-specified; and it establishes de relation between this and the dependent manifest variable. It is a structural model as it identifies measurement models and proposes structural relations between them.

Table 4.37. Chi Square for Structural Model with an Observed Endogenous Variable

Number of distinct sample moments = 55
Number of distinct parameters to be estimated = 20
Degrees of freedom = 55 - 20 = 35
Minimum was achieved
Chi-square = 350.631
Degrees of freedom = 35
Probability level = 0.000

As appreciated in table 4.37, the probability level of chi square established a significant difference between the model and the data. This suposes that the human capital model does not adjust with the variable promedio (GPA).Nevertheless, as pointed out before, this index is unstable with large samples, so that other estimates will be considered.

Table 4.38. Normality Evaluation for Structural Model with an Observed Variable

Multivariate Normality						
	Min	max	Skew	c.r.	Kurtosis	c.r.
Promedi	5.00000	10.00000	0.07478	1.22492	-0.76854	-6.29472
Mt5	0.00000	3.00000	0.83041	13.60284	0.12003	0.98310
Mt4	0.00000	3.00000	0.52918	8.66840	-0.54134	-4.43380
Mt3	0.00000	3.00000	0.67852	11.11468	-0.50485	-4.13491
Mt2	0.00000	3.00000	0.71835	11.76728	-0.25544	-2.09218
Mt1	0.00000	3.00000	0.70220	11.50273	-0.25638	-2.09987
Hv4	0.00000	10.00000	0.59285	9.71141	0.08168	0.66897
Hv3	0.00000	10.00000	0.58978	9.66105	0.17288	1.41593
Hv2	0.00000	11.00000	0.79994	13.10371	0.83921	6.87347

Table 4.38. Continued

Hv1	0.00000	9.00000	0.37616	6.16187	-0.05269	-0.43152
Multivariate				Mardia Coeficient=	-0.01522	-0.01970

The evaluation of multivariate normality in table 4.38 is focused in Mardia' coeficient (- 0.01522).This value is < 1, which is considered a good multivariate normality value.

Table 4.39. Mahalanobis Distance Adjustment for Structural Model with an Observed Variable

Higher scores of Mahalanobis distance			
Observation	Mahalanobis		
Number	d-squared	P1	p2
1541	27.87792	0.00189	0.95231
1393	27.43625	0.00222	0.87215
1280	26.02065	0.00371	0.93734
1411	25.51258	0.00445	0.92717
1534	25.42316	0.00460	0.86136

The Mahalanobis distance values in table 4.39 established that there is no need to eliminate more cases.

Table 4.40. Factor Weights of the Structural Model with an Observed Variable

Regression Weights							
			Estimate	S.E.	C.R.	P	Label
Hv1	←	HV	1.00000				
Hv2	←	HV	2.71903	0.33484	8.12043	0.00000	par-1
Hv3	←	HV	2.63395	0.30857	8.53605	0.00000	par-2
Hv4	←	HV	2.81447	0.35826	7.85601	0.00000	par-3
Mt1	←	MT	1.00000				
Mt2	←	MT	1.47694	0.54724	2.69890	0.00696	par-4
Mt3	<--	MT	5.94129	1.81732	3.26926	0.00108	par-5
Mt4	<--	MT	5.63396	1.73490	3.24743	0.00116	par-6
Mt5	<--	MT	3.55526	1.11507	3.18838	0.00143	par-7
Promedio	<--	HV	1.00000				
Promedio	<--	MT	1.53563	0.69129	2.22140	0.02632	par-8

Table 4.40, reported regression weights with critical ratio values over +-1.96. This indicated that all the subscales and variable weights are significants.

Table 4.41. Standardized Weights for the Structural Model with an Observed Variable

Standardized Regression Weights			
			Estimate
Hv1	<--	HV	0.22783
Hv2	<--	HV	0.50046
Hv3	<--	HV	0.49496
Hv4	<--	HV	0.54214
Mt1	<--	MT	0.11490
Mt2	<--	MT	0.15837
Mt3	<--	MT	0.54320
Mt4	<--	MT	0.56189
Mt5	<--	MT	0.40050
Promedio	<--	HV	0.29204
Promedio	<--	MT	0.10924

In table 4.41, the hierarchy of the predictors can be appreciated. HV with a estimate value of 0.2920 is a better predictor than MT, which reached a value of 0.1092.

Table 4.42. Explained Proportion Variance for GPA

Squared Multiple Correlations			Estimate
		MT	0.00000
		HV	0.00000
		promedio	0.09722
		Mt5	0.16040
		Mt4	0.31572
		Mt2	0.02508
		Mt1	0.01320
		hv4	0.29392
		hv3	0.24498
		hv2	0.25046
		hv1	0.05190

Finally, table 4.42 allows to establish the proportion of explained variance of the structural model with a manifested dependent variable, in this case GPA. In

this model, 9.72 % of the variance associated with the dependent variable promedio (GPA) is determined by two of the three hypothetized predictors: verbal ability (Hv) and mathematics ability (Mt). The factor Mt explains 16 % of the variance associated to the sub-scale Mt5, and the 31 % de la variance associated to Mt4, 29 % of the variance associated to MT3 and 2 % of the variace associated to Mt2, and 1 % of the variance associated with Mt1. The factor verbal ability (Hv) explains 29 % of the variance associated to the subscale Hv4, 24 % of the variance associated to Hv3, 25% of the variancea associated to Hv2, and 5% of the variance associated to Hv1.

4.4.2 Structural Model with a Latent Dependent

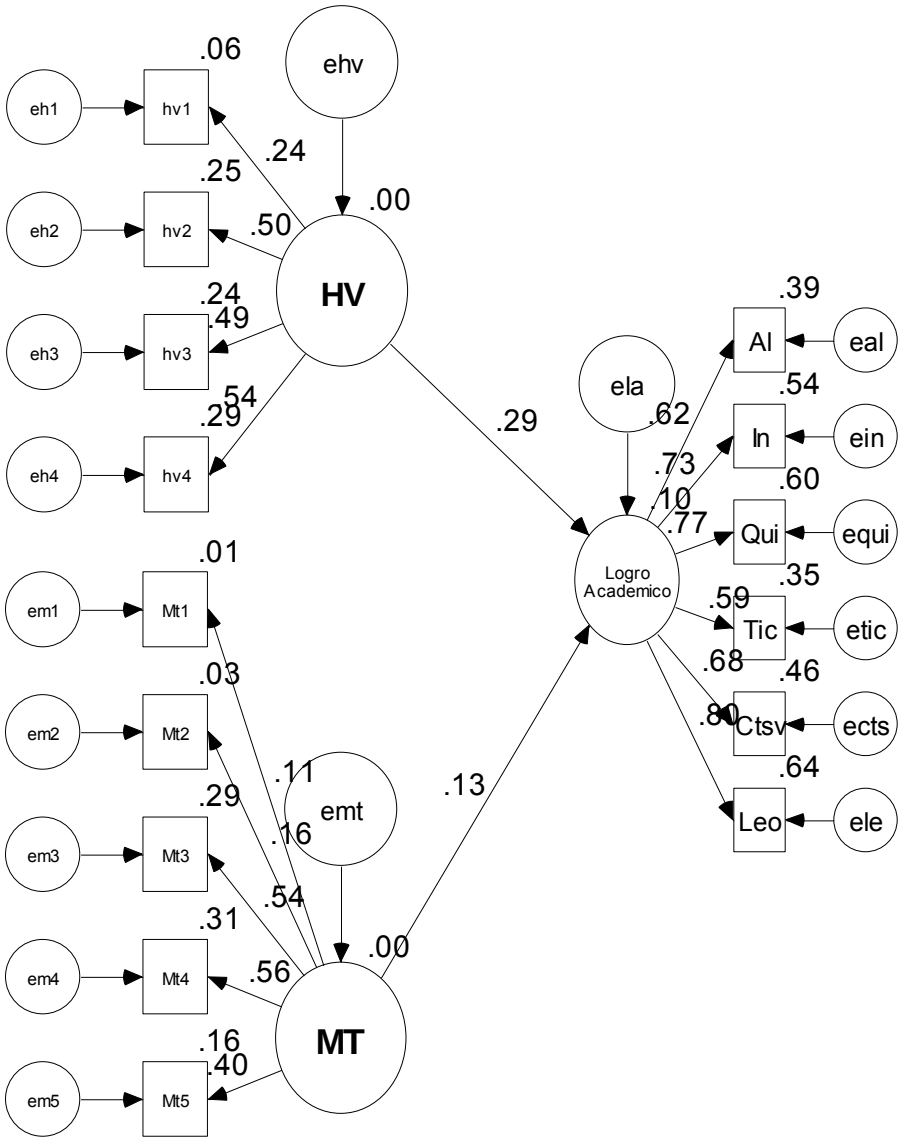

Figure 4.8. Structural model with a latent endogenous variable

Figure 4.8 shows the measurement model of the independent variable after it was re-specified. Also it establishes the relation between this and the dependent latent variable. It is an structural model as it identifies measurement models and proposes structural relations between them.

Table 4.43. Chi Square for the Structural Model with a Latent Endogenous Variable

Computation of degrees of freedom
Number of distinct sample moments = 120
Number of distinct parameters to be estimated = 32
Degrees of freedom = 120 - 32 = 88
Minimum was achieved
Chi-square = 565.669
Degrees of freedom = 88
Probability level = 0.000

In table 4.43 appear the chi square values for the structural model with latent endogenous variable. The probability level shows that the model does not fit to the sample, and consequently, the nil hypotheses is rejected. A wider group of goodness of fit measures will be considered.

Table 4.44. Multivariate Normality of the Structural Model with a Latent Endogenous Variable

Multivariate Normality						
	Min	max	skew	c.r.	kurtosis	c.r.
Leo	5.00000	10.00000	0.11145	1.82565	-1.16348	-9.52937
Ctsv	5.00000	10.00000	-0.30850	-5.05356	-1.10629	-9.06098
Tic	5.00000	10.00000	-0.14282	-2.33960	-1.10745	-9.07053
Qui	5.00000	10.00000	0.11111	1.82005	-1.11337	-9.11897
In	5.00000	10.00000	0.22711	3.72033	-1.06373	-8.71244
Al	5.00000	10.00000	0.76913	12.59911	-0.42677	-3.49542
Mt5	0.00000	3.00000	0.83041	13.60284	0.12003	0.98310
Mt4	0.00000	3.00000	0.52918	8.66840	-0.54134	-4.43380
Mt3	0.00000	3.00000	0.67852	11.11468	-0.50485	-4.13491
Mt2	0.00000	3.00000	0.71835	11.76728	-0.25544	-2.09218
Mt1	0.00000	3.00000	0.70220	11.50273	-0.25638	-2.09987
hv4	0.00000	10.00000	0.59285	9.71141	0.08168	0.66897
hv3	0.00000	10.00000	0.58978	9.66105	0.17288	1.41593
hv2	0.00000	11.00000	0.79994	13.10371	0.83921	6.87347
hv1	0.00000	9.00000	0.37616	6.16187	-0.05269	-0.43152
Multivariate				Mardia Coeficient=	-1.64657	-1.46277

Table 4.44 shows the Mardia coefficient has multivariate normality. This value (-1.64657) is considered good because it is inside the rank of +-1 and 10.

Table 4.45. Mahalanobis Distance for the Structural Model with Latent Endogenous Variable

Observations farthest from the centroid (Mahalanobis distance)			
Observation	Mahalanobis		
Number	d-squared	p1	p2
1197	37.17073	0.00119	0.85410
892	36.14360	0.00169	0.75403
1393	36.12508	0.00170	0.51390
1332	35.43705	0.00213	0.44809
1126	34.76261	0.00266	0.42556

The Mahalanobis distance in table 4.45 is adjusting at 0.001 in the first report, this means that there are no significant outliers to delete and that the gained Mardia's coefficient is the best multivariate normality obtained by this means..

Table 4.46. Factor Weight of the Structural Model with a Latent Endogenous Variable

Regression Weights							
			Estimate	S.E.	C.R.	P	Label
Logro_Academico	←	HV	0.6824	0.1300	5.2488	0.0000	par-13
Logro_Academico	←	MT	1.2902	0.5742	2.2468	0.0246	par-14
hv1	<--	HV	1.0000				
hv2	<--	HV	2.5394	0.3954	6.4212	0.0000	par-1
hv3	<--	HV	2.4514	0.3754	6.5288	0.0000	par-2
hv4	<--	HV	2.6068	0.4190	6.2213	0.0000	par-3
Mt1	<--	MT	1.0000				
Mt2	<--	MT	1.4836	0.5491	2.7016	0.00690	par-4
Mt3	<--	MT	5.9402	1.8172	3.2687	0.0010	par-5
Mt4	<--	MT	5.6257	1.7322	3.2476	0.0011	par-6
Mt5	<--	MT	3.5685	1.1196	3.1873	0.0014	par-7

Table 4.46. Continued

Al	<--	Logro _ académico	1.0000				
In	<--	Logro _ académico	1.3237	0.05563	23.7972	0.0000	par-8
Qui	<--	Logro _ académico	1.3682	0.0551	24.7926	0.0000	par-9
Tic	<--	Logro _ académico	1.0815	0.0549	19.7017	0.0000	par-10
Ctsv	<--	Logro_Académico	1.3133	0.0599	21.9086	0.0000	par-11
Leo	<--	Logro_Académico	1.4735	0.0598	24.635	0.0000	par-12

Table 4.46. shows the critical ratio values of the factor weights for the complete structural model with latent endogenous variable. All these values are significant because they are up to +- 1.96 .

Table 4.47. Factor Standardized Weights for the Structural Model with a Latent Dependent Variable

Standardized Regression Weights			
			Estimate
Logro_Academico	<--	HV	0.29241
Logro_Academico	<--	MT	0.12533
Hv1	<--	HV	0.24427
Hv2	<--	HV	0.50202
Hv3	<--	HV	0.49478
hv4	<--	HV	0.53933

Table 4.47. Continued

Mt1	<--	MT	0.11485
Mt2	<--	MT	0.15903
Mt3	<--	MT	0.54289
Mt4	<--	MT	0.56084
Mt5	<--	MT	0.40184
Al	<--	Logro_Academico	0.62294
In	<--	Logro_Academico	0.73283
Qui	<--	Logro_Academico	0.77440
Tic	<--	Logro_Academico	0.58788
Ctsv	<--	Logro_Academico	0.67540
Leo	<--	Logro_Academico	0.79858

Standardized regression weights, reported in table 4.47, showed the hierarchy of the two independent variables. These values, in terms of explained variance were 29.24 % for Hv and 12.53 % for Mt. This way, verbal ability is a better predictor than mathematics abilities.

Table 4.48. Propotion of Variance Explained for the Structural Model with Latent Variable

Squared Multiple Correlations			
			Estimate
		MT	0.00000
		HV	0.00000
		Logro _ académico	0.10121
		Leo	0.63774
		Ctsv	0.45617
		Tic	0.34560
		Qui	0.59969
		In	0.53705
		Al	0.38806
		Mt5	0.16148
		Mt4	0.31454
		Mt3	0.29473
		Mt2	0.02529
		Mt1	0.01319
		hv4	0.29088
		hv3	0.24480
		hv2	0.25202
		hv1	0.05967

Table 4.48 reported the proportion of variance explained in the structural model with latent dependent. The structural model can explain only 10.12 % of the variance of logro académico (academic achievement). This means that 10.2% of the variance associated with the dependent variable logro académico was determined for two of the three hypothetized independent variables: verbal hability (Hv) and mathematics ability (Hm).

The factor logro académico (La) explains 63% of the variance associated with the course Leo, and 45% of the variance associated with the course Ctsv, the 34 % of the variance associated with the course TIC, 59% of the variance associated with the course Qui. 53% of the variance associated the course In, and 38% of the variance associated with Al.

The factor mathematics ability (Mt) explains 16% of the variance associated to the subscale Mt5, 31% of the variance associated to the subscale Mt4, 29 % of the variance associated to the subscale Mt3, 2% of the variance associated to the subscale Mt2, and 1% of the variance associated to the subscale Mt1.

The factor verbal ability (Hv) explains 29 % of the variance associated to the subscale Hv4, 24% of the variance associated to the subscale Hv3, 25% of the variance associated to the subscale Hv2, and 5% of the variance associated to the subscale Hv1.

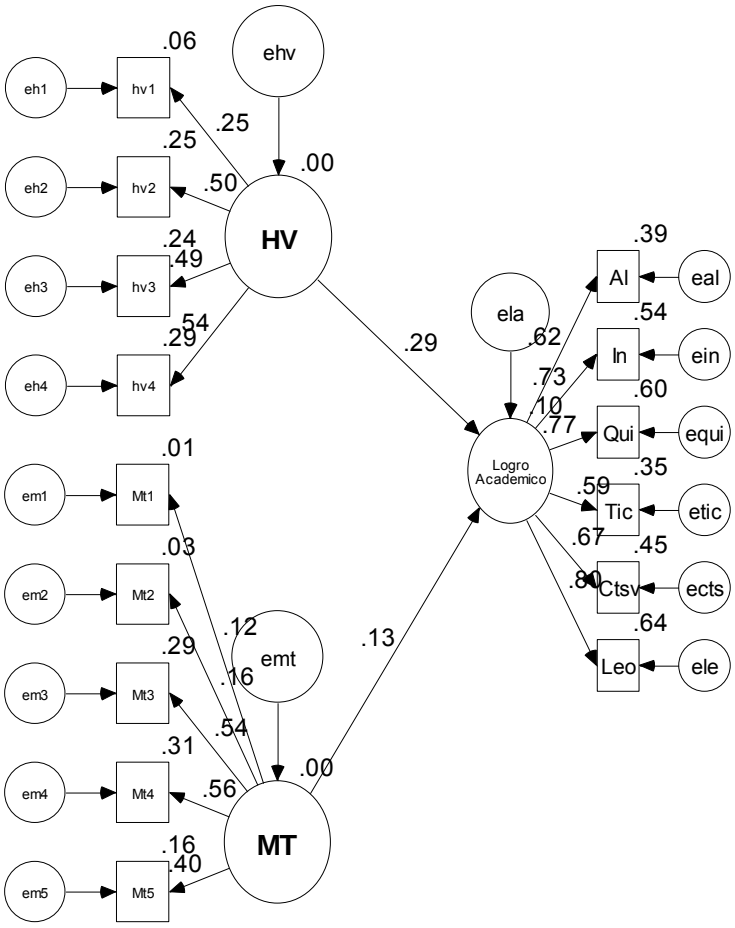

Figure 4.9. Structural model with a latent endogenous variables, standardized version.

Table 4.49. Comparative Table of Fit Measures for the Observed and Latent Variable

Fit Measures	Observed endogenous and latent endogenous variable			
Fit Measure	Obseved	Latent	Macro	Criterion
Discrepancy	350.04797	565.66923	CMIN	Menor Xi2
Degrees of freedom	35	88	DF	Mayor
P	0.00000	0.00000	P	0.01 y 0.05
Number of parameters	20	32	NPAR	Overidentified
Discrepancy / df	10.00137	6.42806	CMINDF	b:< 2.1 m: 2.1 y 3.1
RMR	0.14554	0.12018	RMR	< 0.05 o menos
GFI	0.96140	0.95566	GFI	0-1 m:90-95 b: 95
Adjusted GFI	0.93934	0.93953	AGFI	0-1 acep: .90

Table 4.49. Continued

Parsimony-adjusted GFI	0.61180	0.70082	PGFI	0-1 No aplica
Normed fit index	0.68690	0.88589	NFI	0-1 .90
Relative fit index	0.59744	0.86385	RFI	0-1
Incremental fit index	0.70910	0.90190	IFI	0-1
Tucker-Lewis index	0.62250	0.88254	TLI	0-1 acep: .90
Comparative fit index	0.70639	0.90156	CFI	0-1
Parsimony ratio	0.77778	0.83810	PRATIO	
Parsimony-adjusted NFI	0.53426	0.74246	PNFI	No aplica
Parsimony-adjusted CFI	0.54941	0.75559	PCFI	0-1
Noncentrality parameter estimate	315.04797	477.66923	NCP	Rangos no aplica
NCP lower bound	258.74166	406.23923	NCPLO	
NCP upper bound	378.81649	556.59274	NCPHI	
FMIN	0.21756	0.35157	FMIN	
F0	0.19580	0.29687	F0	Rangos
F0 lower bound	0.16081	0.25248	F0LO	
F0 upper bound	0.23544	0.34592	F0HI	
RMSEA	0.07480	0.05808	RMSEA	< 0.06 o menos
RMSEA lower bound	0.06778	0.05356	RMSEALO	
RMSEA upper bound	0.08202	0.06270	RMSEAHI	
P for test of close fit	0.00002	0.00179	PCLOSE	
Akaike information criterion (AIC)	390.04797	629.6692	AIC	Cerca del cero No aplica
Browne-Cudeck	390.3233	630.3120	BCC	
Bayes information criterion	543.77946	888.61450	BIC	
Consistent AIC	517.72776	833.95689	CAIC	
Expected cross validation index	0.24242	0.39134	ECVI	Rangos No aplica

Table 4.49. Continued

ECVI lower bound	0.20742	0.34695	ECVILO	
ECVI upper bound	0.28205	0.44039	ECVIHI	
MECVI	0.24259	0.39174	MECVI	No aplica
Hoelter .05 index	229	316	HFIVE	Arriba de 200
Hoelter .01 index	264	347	HONE	Arriba de 200

Table 4.49 shows the comparision of fit measures for the two versions of structural model. In both cases, the chi square (CMIN), CMIN/DF and RMR reported values out of the limit for establishing a good fit.GFI, AGFI and Hoelter reached values considered good in both models. NFI and RMSEA indicated good fit for the latent endogenous but not for the observed endogenous. In global terms it can be concluded that the structural model with a latent endogenous variable reached a better goodness of fit (six parameters) than the structural model of the observed endogenous variable (four parameters).

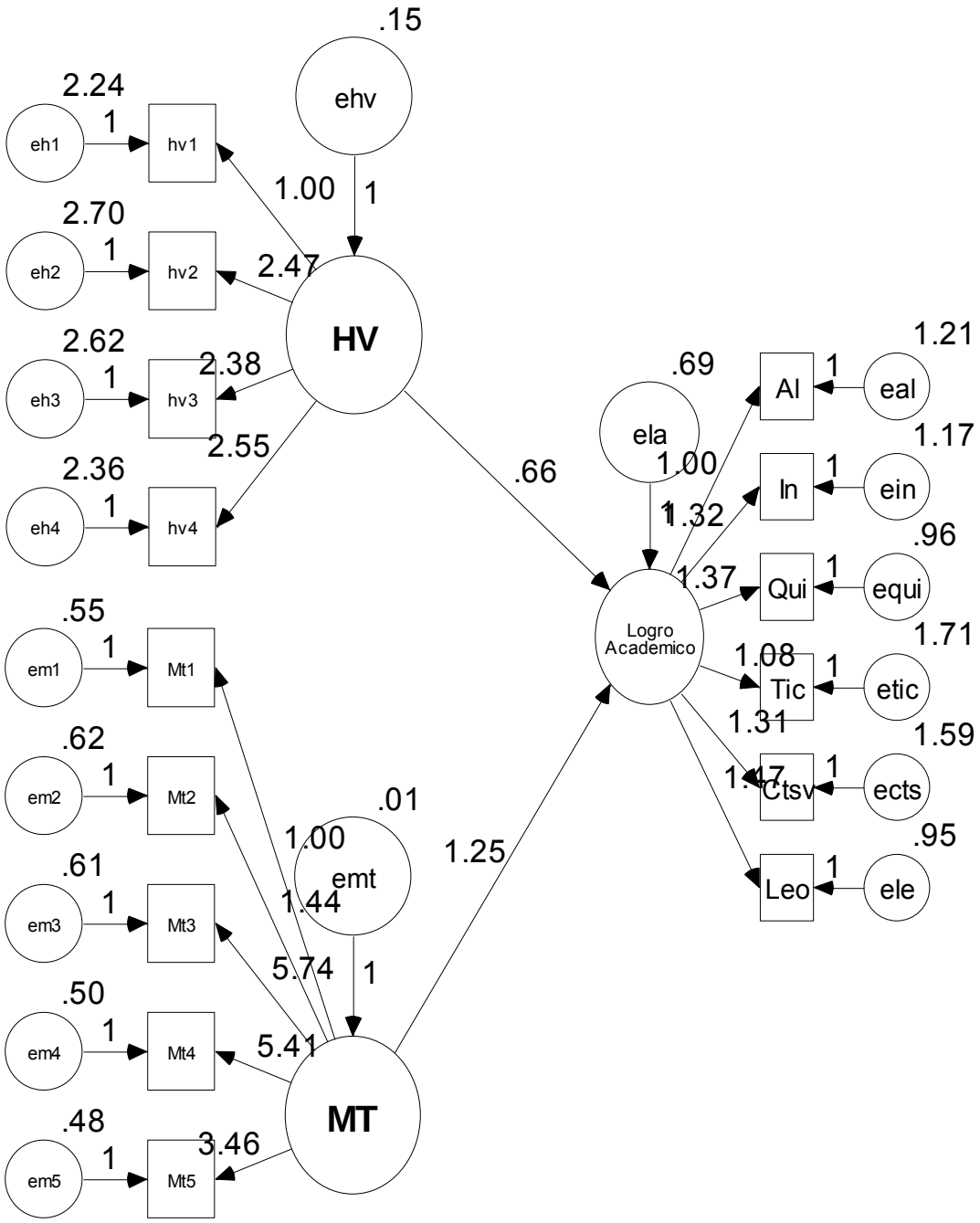

Figure 4.10 Structural model of latent endogenous variable, understandardized version

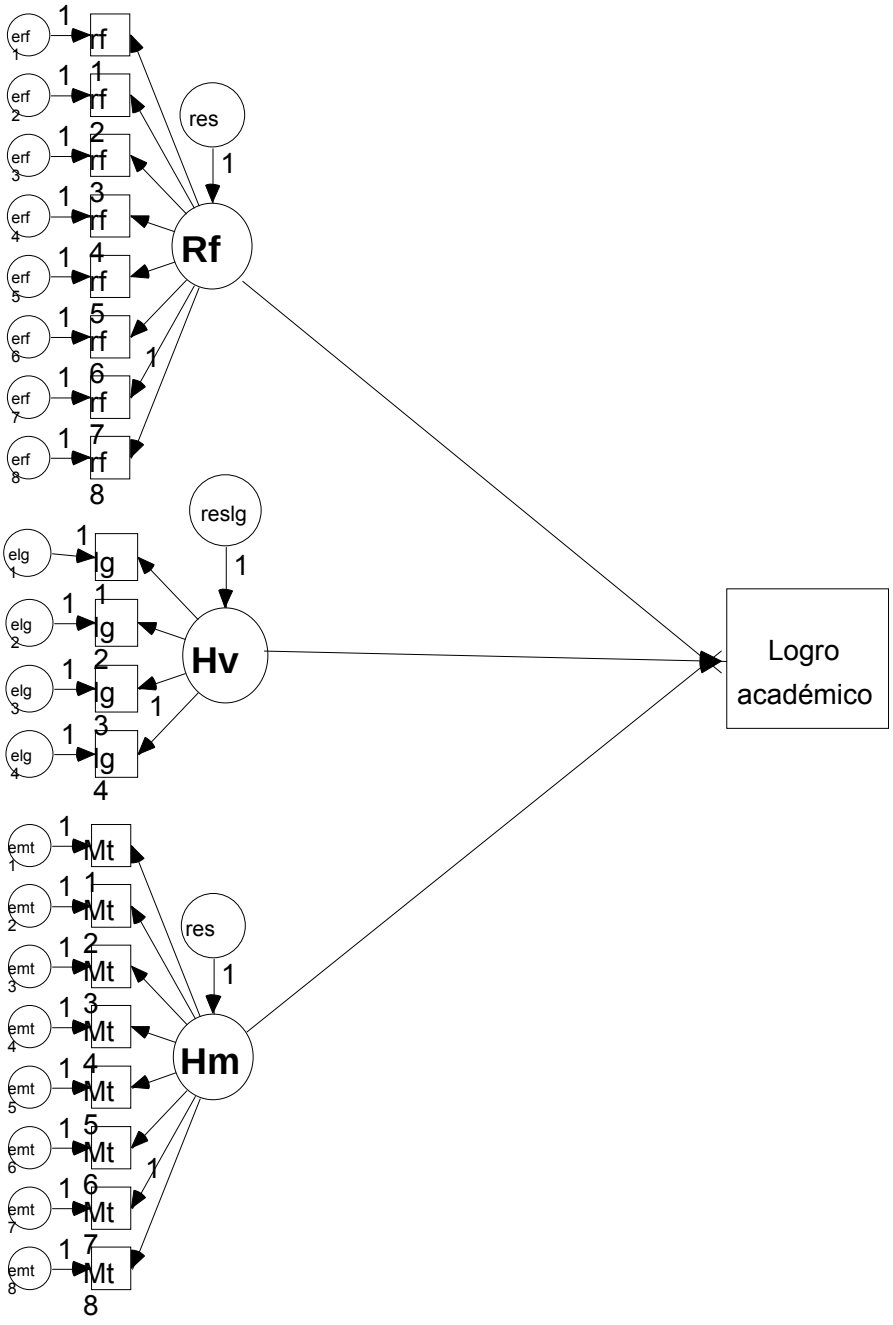

Figure 4.11 Structural model of manifiest endogenous variable

4.5 Statistical Hypotheses

The research hypothesis (H1) of this study established that the key competences are significant factors in the explanation of the academic achievement. The results of this study documented that the structural model of human capital with the dependent variable logro académico (academic achievement) significantly fits with the data of the sample and consequently it can be said that it fails to reject the nil hypothesis. This means that, based on the results of the study it can be affrimed that human capital explains, although in a little proportion, significantly the academic achievement. It can be also affirmed that comparing the two analyzed conceptions, the structural model for logro académico (academic achievement) is more consistent than the model of promedio (GPA).

The process to validate the constructs of the measurement model departed from the simple to the complex. Demographic variables were analyzed and a student profile was established. Further, each one of the three components of the measurement model was analyzed through a confirmatory factor analysis. The same procedure was done for the measurement model of the endogenous variable.

The validation process was progresive following an specific sequence.It evaluated the multivariate normality with Miardia coeficient; normality was adjusted deleting the appropiated outliers with Mahalanobis distance criteria; graphic models were specified; factor weight were evaluated; goodness of fit measures

were done; in the structural model, standardized factor weights were analyzed to establish variance explained and to define the hierarchy of predictors; square muiltiple correlation was also done to establish the proportion of variance explained for each factor in the model.When corresponded, models were respecified.

The human capital model validated, as its components, the next: 1) factor Hv (verbal ability) and its subscales h1 (comprensión de la lectura),h2 (analogias),h3 (complementación de enunciados) and h4 (antonimos); 2) Factor Mt and its subscales Mt1 (comprensión de los enunciados que se leen), Mt2 (capacidad para establecer inferencias lógicas), Mt3 (capacidad para realizar generalizaciones), Mt4 (capacidad de abstracción reflexiva), Mt5 (capacidad para establecer relaciones) and Mt8 (capacidad de imaginación).

Factor Hv and Mt are valid constructs that represents human capital. They were also consistent and valid in the measurement of the mathematics abilities and verbal abilities, but not in the case of formal reasoning. The scales, once depured, were consistent.

Regarding the study hypotheses, the next can be said:

- Verbal ability is the key competence that better explain the academic achievement. This hypothesis is true if we consider that in the measurement model of human capital, its four scales loaded this factor and appeared as a better predictor than mathematics ability.
- Mathematics abilities are the key competences that better explain the academic achievement (logro académico). This hypothesis is false

considered that the measurement model of human capital only adjusted and, although the human capital was saved as a respecified factor (excluding mt6 and mt7), in the comparison with verbal ability resulted not to be the best predictor of the model.

- Formal reasoning is the key competence that better explain the academic achievment. This hypothesis is false if considered that in the measurement model of human capital, none of the eight components loaded the factor Formal reasoning (Rf). For this reason, the factor formal resoning was excluded from the respecification of the human capital model.

The respecification of the measurement model considered only factors Hv and Mt, once depured the subscales that did not load the factor Mt (mt6 and mt7). A measurement model for the academic achievement variable was built, which loaded the six subscales and was validated before including in the structural model.

The structural model was designed in two modalities to be compared: Human capital in front of an observed dependent variable, and human capital in front of a latent dependent variable. The specialized literature impossed this division (Jonson, 1992) and it was the base of the methodologic and conceptual design of the study. In this context, the next discussion about the hypotheses of the structural model was formulated:

- The competences are not important factors in the explanation of academic achievement (H0). This hypotheses is false in the two model that were tested.In the structural model of the dependent variable promedio (GPA),

the model adjusted and basically it failed to reject the nil hypothesis. For this reason, it was accepted that key competences in this model of human capital explained part of the variance for the variable promedio (GPA). In the structural model of the dependent variable academic achievement (logro academico), the model adjusted and basically it failed to reject the nil hypothesis. For this reason, it was accepted that key competences in this model of human capital explain a proportion of the variance for the factor academic achievement. Although this conclusion is valid for both structural models, it must be outlined that, for one of the models- the one of the adjusted factor (latent endogenous)-, this conclusion is barely more valid.

- Key competences are important factors in the explanation of academic achievement (H1). This hypothesis is true although, certainly, their specific weights as predictor are weak and low in this model. From the components of human capital, verbal ability is better predictor than mathematics ability, although both factors explained little proportion of variance. From the two dependent variables, academic achievement is barely a better predictor than promedio (GPA).

CHAPTER 5

CONCLUSIONS

In this chapter, the conclusions are established with an emphasys on its main findings.

The research hypothesis of this study establishes that the key competences are important factors in academic achievement. The findings of the study sustent this research hypothesis. Therefore, It can be afirmed that the results of this study justify the interpretation that human capital, in the cognitive version of Salganik, Rychen, Moser & Konstant (1999), explains academic achievement under the two alternatives this study considered. A second finding determines that although both options are methodologically valid, the factorial adjusted version has a wider predictive capacity then the traditional version.

These conclusions allow us to take position in a methodological (Stevens, 1996; Kline, 1998; Byrne, 2001) and theoretical (Schultz, 1961; Becker,1964; DeSeCo, 2005) debate developed trough the last 70 years between the researchers that support a traditional position; defending the convenience of GPA (Linn, 1966; Samejima, 1969; Arias y Chávez, 2002) and those who support a critic perspective in which compensatory values have to be established trough adjusted versions of GPA (Bejar y Blew, 1981; Young, 1990; Young, 1990b; Stricker, 1994; Ziomek, 1995; Caulkins, Larkey and Wei, 1996; Greenwald and

Gillmore, 1997; Johnson, 1997; Hoover, 1999; Lei, Bassiri and Schulz, 2001), in this particular case an adjusted factorial (Jhonson, 1997) . The findings of this study allow us to abandon the traditional concept in the extent that they confirm the wider predictive capacity of the adjusted factorial.

As well, the findings of this study allow to stand among traditional conceptions of human capital (Schultz, 1961; Becker,1964; Caudill y Gropper, 1991; Etcheverry, 1996; Fägerlind, 1998; Moore y Keith, 1992; Schultz, 1993) and cognitive conceptions of human capital (OCDE, 1992; OCDE, 1993; OCDE, 1997; PISA,1999; Salganik, Rychen, Moser y Konstant, 1999; OCDE, 1998; Rychen, Salganik, and McLaughlin, 2001; Rychen y Salganik, 2003ª; Rychen y Salganik, 2003b; PISA, 2005). The finidngs allow us to validate the cognitive conception of human capital.

The results of the study allow us to sustain that, in the methodological aspect, the structural equation modeling is a pertinent resource in the validation of instruments, measure models with latent variables and structural models; as well as, in the theoretical aspect, human capital in its cognitive version is a concept with a wide capacity of explanation, far beyond the traditional conceptions of human capital as merely an integration of knowledge and abilities; as in the technical aspect, that the concept of GPA has less predictive validity than academnic achievement (adjusted factorial).

5.1 Findings of the Measure Model Constructs

In Rychen & Slaganik's key competences (2003b), human capital model has three components and each one of them has the same importance as the

other two. The most important result of this study states that the human capital model needs to be re-defined, and the new model is composed of two factors. One of them: verbal abilities, is more important than the other one: mathematics abilities. The validation of the human capital model included the four components of the verbal abilities: reading comprehension, analogies, complementation of statements and the use of antonyms; and six of the eight components of mathematics abilities: comprehension of the statements, the capacity for logical inferences, the capacity for generalizations, the capacity of reflexive abstraction, the capacity to establish relations and the capacity for imagination. The same procedure used in the validation of this group of constructs allowed the validation of the measure instrument also.

Regarding this study's hypotheses, it said that:

The verbal ability is the key competence that better explains the academic achievement. Mathematical ability partially explained academic achievement in the first model and once adjusted figured as the second relevant component between the key competences of the new model. Formal reasoning did not explain academic achievement in any of its eight scales. This is the reason that explains why the key competences model lost one of its components and why the new model composed only for two factors: verbal ability and mathematics ability. The measure model specified as La = rf + hv + hm +e, was re-defined and considering these findings, it must be specified as La = hv + hm + e . The new ENLACE test, applied in October 2007, is held in this same conceptual model and, different from

the COSNET test, currently it only considers the two factors refered here, excluding the formal reasoning factor from its structure.

In the definitions of key competences (DeSeCo, 2005) and in the formulation of the theoretical model of human capital (Salganik, Rychen, Moser & Konstant, 1999), the three components of human capital had the same hierarchy and consequently; language, mathematics abilities and formal reasoning where conceived as balanced factors of the same weigh and consistence. The three first hypotheses of this study deliberately questioned that balance as they challenged the dominance of each one of them against their condition of balanced theoretical components. From this perspective, the hypotheses were oriented to discard (Popper,1963) the human capital theory instead of demostrating it.

A first theoretical implication is related to the structure of the human capital theory, in its cognitive approach (Rychen, Salganik, and McLaughlin, 2001). In this conception, human capital is integrated by three components (formal reasoning, mathematics abilities and language abilities) and there are no hierarchy differences between them. The results of this study justify a new model of human capital of a cognitive orientation, in which only mathematical and verbal abilities compose the model, where verbal ability is sensitively more important than mathematics skill. There are two components in the new model and one of them has more importance than the other one. The new structural equation, sustained in the findings of this study is therefore La = hv + hm + e.

A second theoretical implication relates to the problem of academical achievement. In the academic discussion of this matter, traditional approaches

prevail and these still consider GPA as the key indicator for the evaluation of scholar success (Arias & Chavez, 2002). Our study allows us to sustain a critical approach toward that position, as the comparison of the endogenous measure models ilustrates on the advantages of the adjusted factorial compared to the GPA. In the comparison of the two structural models (observed endogenous and latent endogenous), the higher predictive value of the adjusted GPA became evident. Although the difference found between La (observed) = hv + hm +e and La (latent) = hv + hm + e is little, it is still a significative difference in two senses. First, because it validates important apreciations in the specialized literature (Johnson, 1997) and second, because it holds the importance of considering biographic and pedagogic factor beyon the isolated evaluation of the academical achievement of the students from the teacher.

The third important implication relates to the process of First Entrance Evaluation of the Technological High School Education System, and it's one of a practical nature. The COSNET evaluation has been questioned among the teachers of the sub-system trough years, mostly because of its limited predictive value. This means that the students that scord high grades in the test were not necessarily achieved better in school. The test itself was never standardized for the profile of the particular student it has been oriented to, and there was never an open analysis process to allow a systematic critical effort to guide its developement as an evaluation instrument. Particularly, it was held on constructivist conceptions, which were justified as a guarantee of integrity and validity as a diagnostic instrument. For that reason, the fact that precisely the

formal reasoning factor resulted non-validated in the evaluation of the measurement model in any of its sub-scales, isn't at all secondary.

The study contributes to the investigation of human capital in three relevant aspects. First, in the depuration of the factors that compose the measure model of human capital, as it excludes, on a strict methodological basis, the formal reasoning as a part of the human capital model. Second, in the introduction of a methodology for the analysis of the evaluation instruments such as the COSNET test, as well as the theoretical conceptions that sustain them (Rychen y Salganik, 2004; DeSeCo, 2005) introducing the analysis of structural equation models in the hypothesis test (Byrne, 2001). Third, in the depuration of the different approaches on academic achievement, by comparing the traditional conception of GPA to the concept of adjusted factorial, modestly contributing to the debate that sustains that the dependant factorial has a wider predictive validity than the GPA dependant (Jhonson, 1997).

5.2 Findings of the Structural Model

The structural model composed from the exogenous and endogenous models and the findings of our study suppose a structural relation between them.

The exogenous variable, key competences, now integrated by two components (verbal abilities and mathematical abilities), explains in a modest but significant way the endogenous variable, academical achievement, in its GPA version as in its adjusted factorial version. In the case of the GPA version, the predictive validity of the model is barely a bit weaker. The version of adjusted factorial is, in the other hand, barely a bit more consistent.

5.3 Implications for Educational Policies

Which are the implications of this findings for the educational policies in Nuevo Leon?. There are two kinds of implications: regional and national. In the level of Nuevo Leon state, the findings of this study are significant as they ease the understanding of theorietical frameworks that hold academical achievement evaluations, such as the PISA test (PISA, 2006). The state of Nuevo Leon has showed significantly poor results in this test. In the current integral reform (2006), SEMS is still pending to establish the academical achievement criteria. The findings of this study hold reccomendations to focus the educational evaluation critera to conceptions with a wider predictive value in the explanation of academical achievement. From the approach of the curricular reform, it is important to highlight language and mathematical skills in the composition of the curriculum for the efficient promotion of significative academical achievements in the context of the conceptions of OCED. The comparative studies of that institution have represented an important critic to the current educational model in Mexican High School (the mechanization and memorization of knowledge) and the findings of this study offer the opportunity to validate in our own institution , with our own students, one of the human capital model that support such evaluations.

In the other hand, the main implication coming out of this study's results in the national level, assumes that the decisions on educational policies concerning academical achievement in high school have to be based in the concrete research of the factors that are significant to it. The case of the COSNET evaluation treated here illustrates the opposite process in which an evaluation is designed and used

trough the years without opening it to the analysis of the involved academics. Finally, a second national evaluation, called ENLACE, is being announced and the new theoretical model that supports it is redefined. Given the recent appear of the ENLACE test for basic education (2 years) and the pilot phase in high school, it doesn't yet exist a systemathic study to analize its results.

How can this findings impact the standards of the employers?. The improvements in the academical achievement of the students will be significant in the context of an educational reform that considers the key competences as the basis for the definition of the professional profiles of their graduates. They as well promote a graduate profile based in key competences. This means that the goals of the curriculum aim to the systematic development of this kind of competences. About the employers, it is important to visualize that theese competences are an important part of the international standards, such as OCED. Locally, the international employers hold high competitive standards. From that perspective, to focus the educational reform of high scholl in a competence oriented model has the purpose of impacting the international standards that define the quality of the laboral skills and knowledge. The requirement of an international technical certification for the students of technological high school is oriented in that direction.

5.4 Summary of Findings

The folowing sentences summarize the most important findings in this research study.

- Human capital in its cognitive version explains academical achievement.
- The latent or factorial version of academical achievement has a more wide predictive capacity than the traditional version.
- The new measure model of human capital required to be re-specified and it is now composed only of two factors, plus the error: La = v + hm +e. Verbal ability is the key competence that best explain academical achievement, while the second important component is mathematical skill.
- Although the difference found between La (observed) = Hv + hm +e and La (latent) = Hv + hm + e is little, it is still a significative difference in two senses. First, because it validates important apreciations in the specialized literature (Johnson, 1997) and second, because it holds the importance of considering biographic and pedagogic factor beyon the isolated evaluation of the academical achievement of the students from the teacher.

- The evaluation of the formal reasoning component was not factorialy held in any of its sub-scales.
- The exogenous variable (key competences), now integrated by two components: verbal abilities and mathematical skills, explains in a little but significant way the endogenous variable

(academical achievemnet), in its GPA version and in its adjusted factorial version.

- The analysis of structural moments is a resource pertinent to the evaluation of the hypothesis test, to the validation of the measure instrument, to the validetion of measure model with latent variables and to the validation of structural models.

APPENDIX A.

DEPENDENT VARIABLE

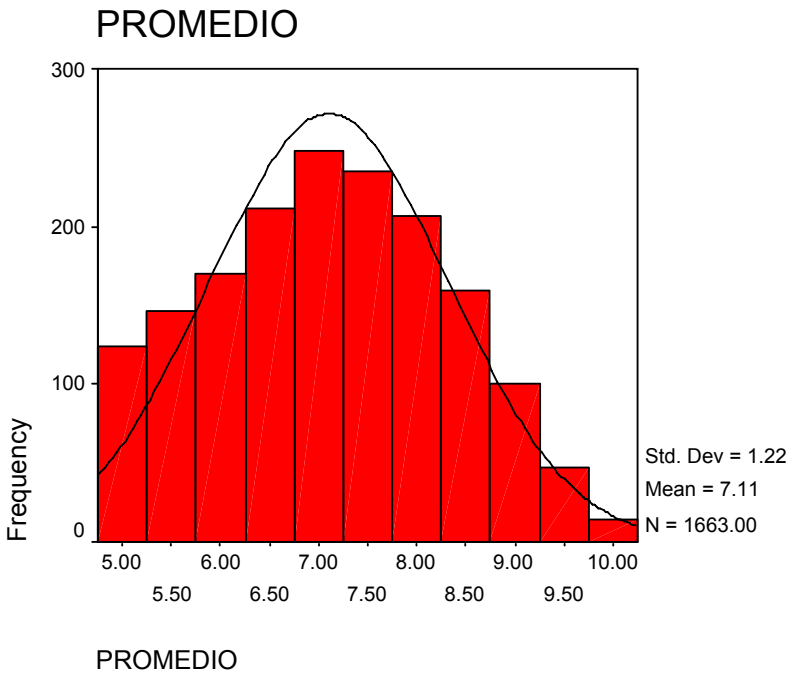

Figure A1. Histogram with GPA and Standard Deviation.

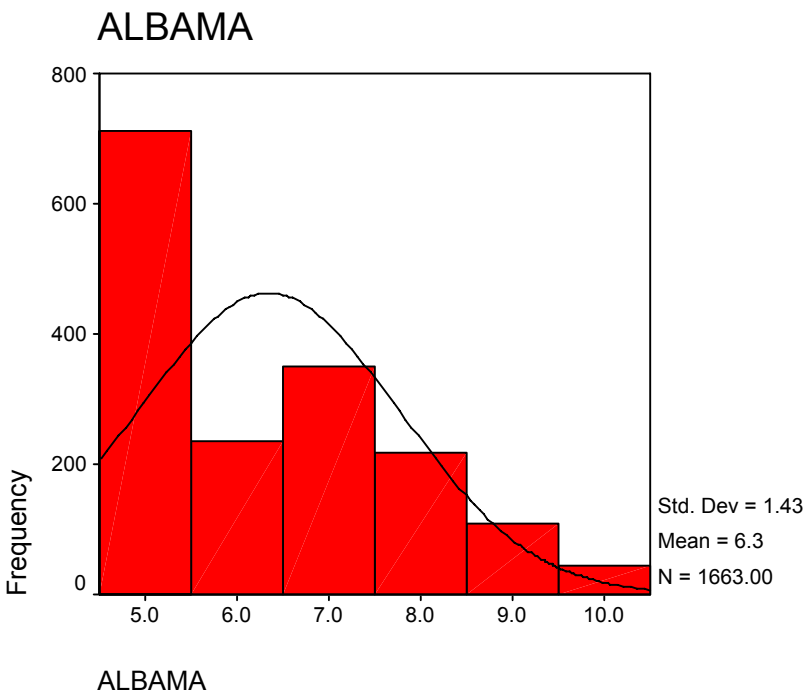

Figure A2. Histogram of algebra with GPA and stamdard deviation.

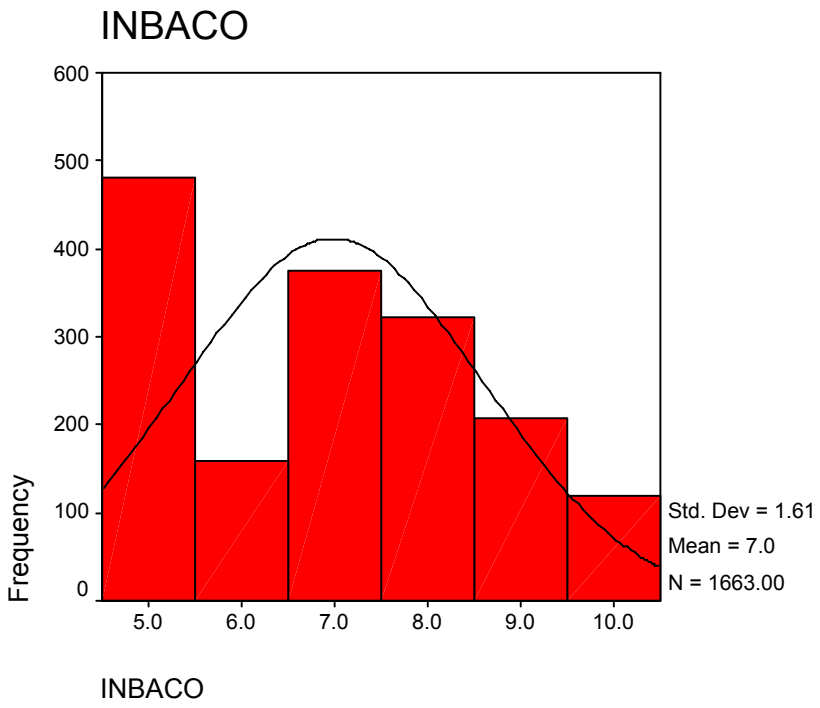

Figure A3. Histogram of english with GPA and standard deviation.

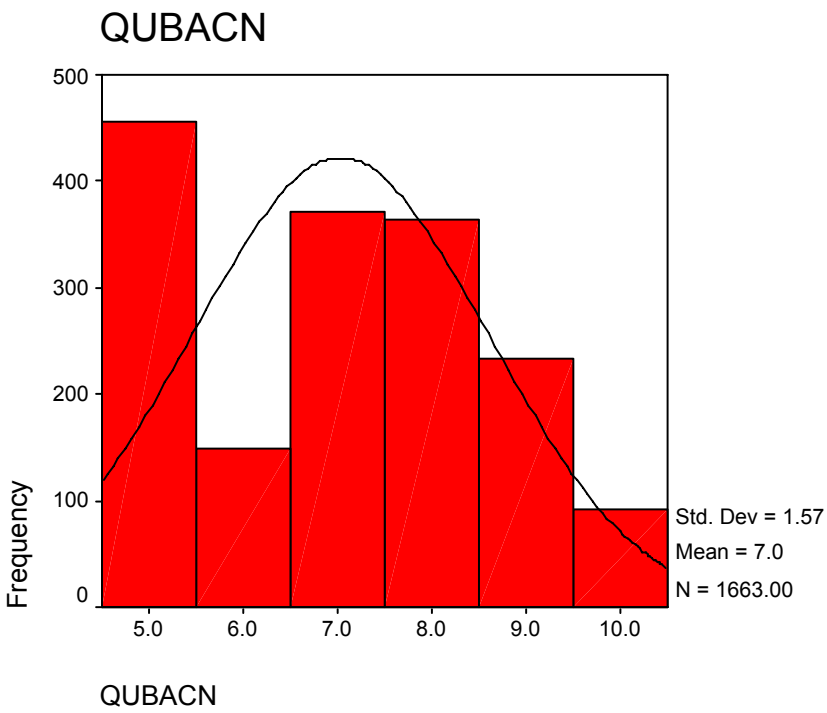

Figure A4. Histogram of chemistry with GPA and standard deviation.

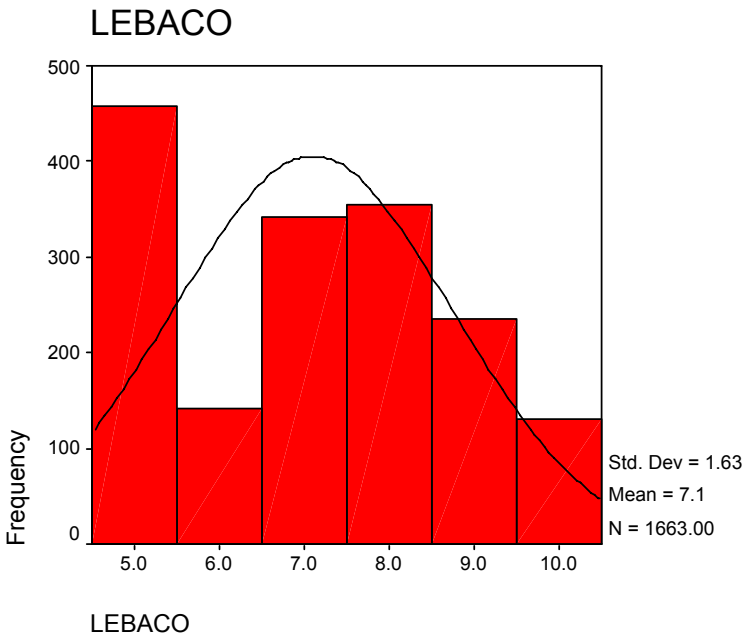

Figure A5. Histogram of reading and written and verbal expression with GPA and standard deviation.

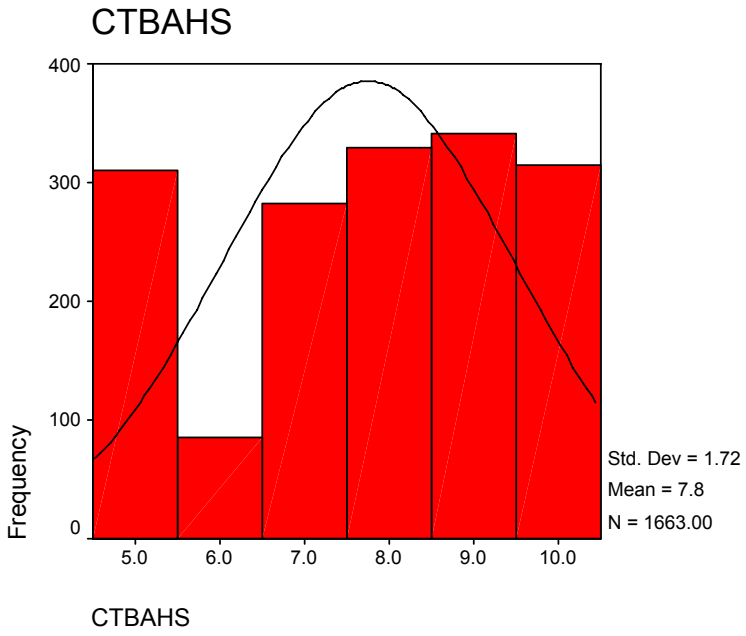

Figure A6. Histogram of science, technology, society and values with GPA and standard deviation.

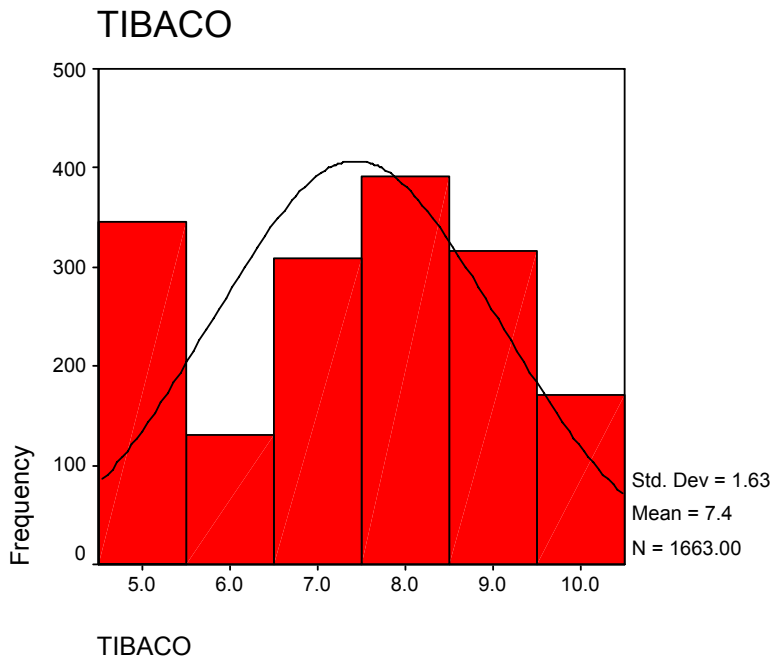

Figure A7. Histogram of TIC with GPA and standard deviation.

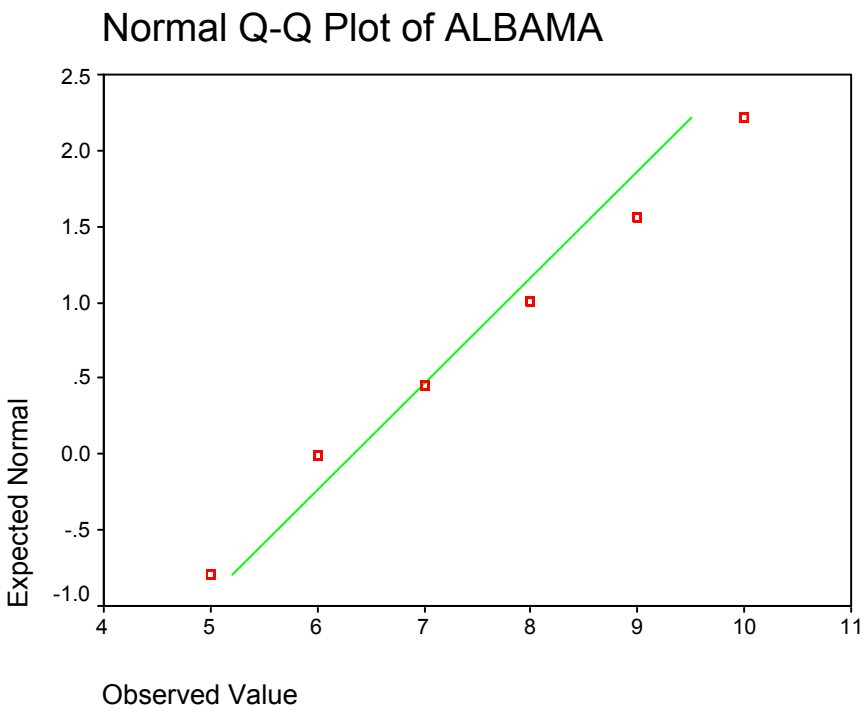

Figure A8. Normal Q-Q plot of algebra

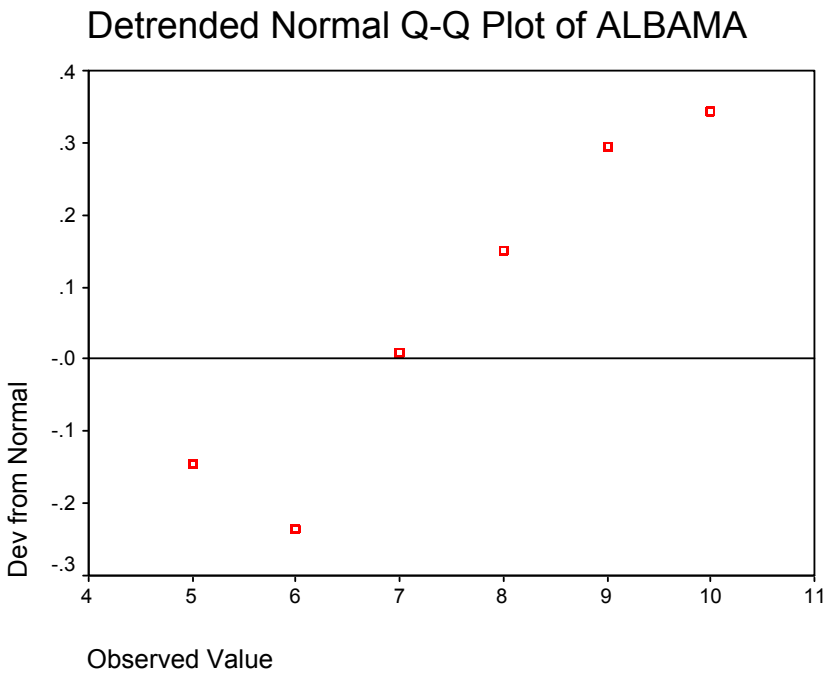

Figure A9. Detrended of algebra

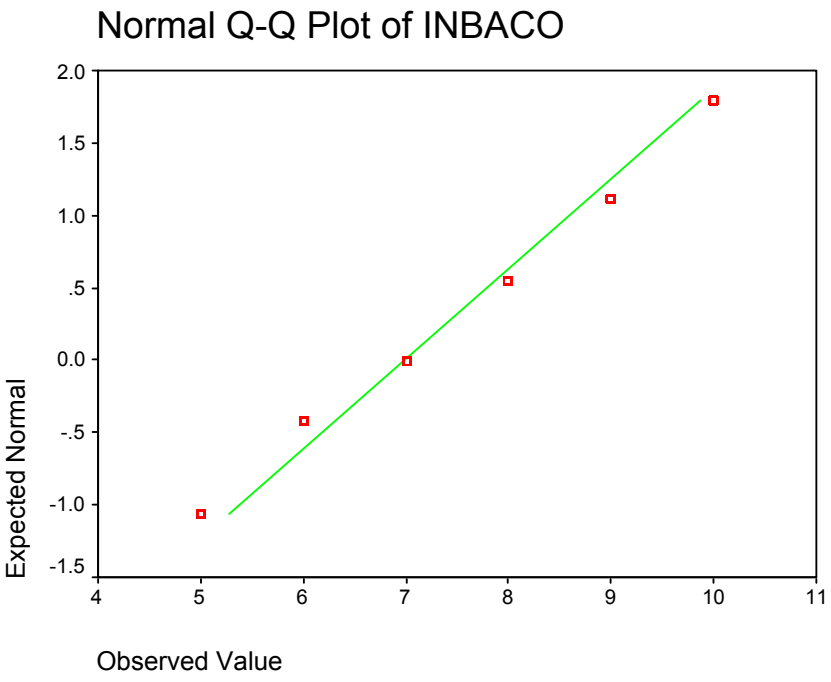

Figure A10. Normal Q-Q plot of English

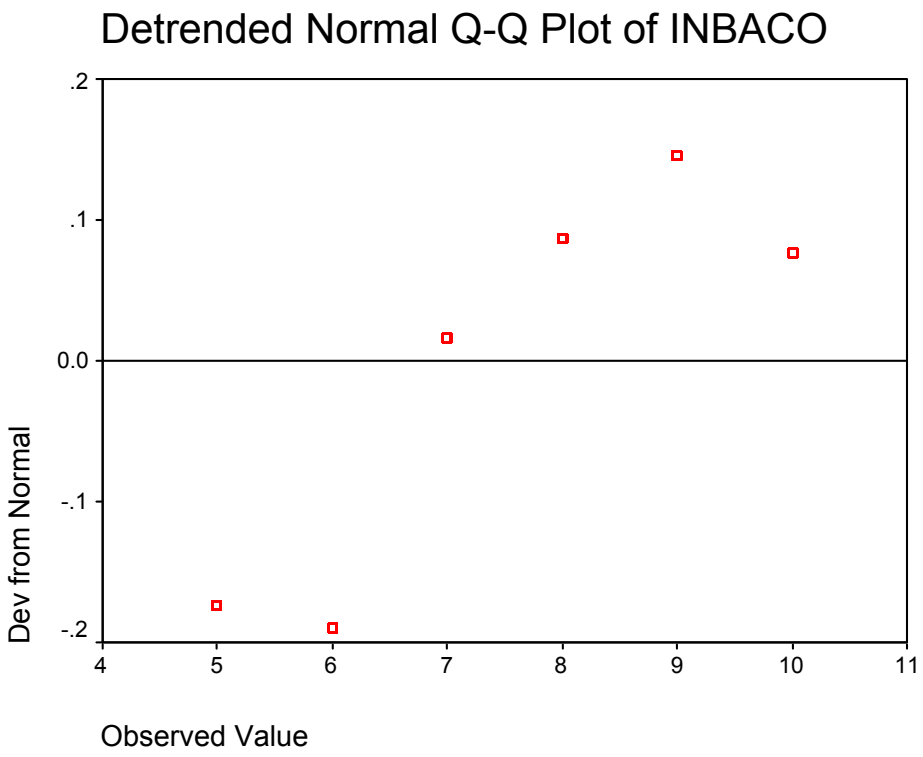

Figure A11. Detrended of English

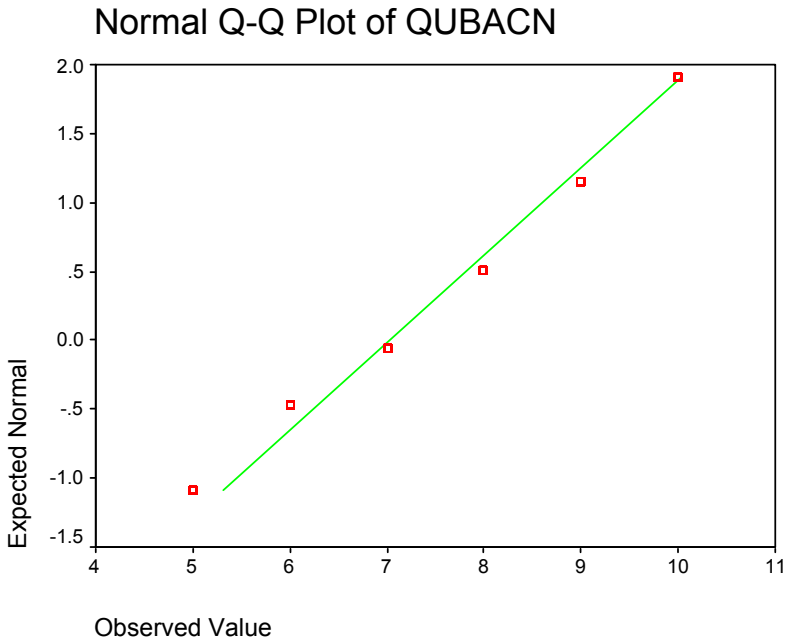

Figure A12. Normal Q-Q plot of chemistry

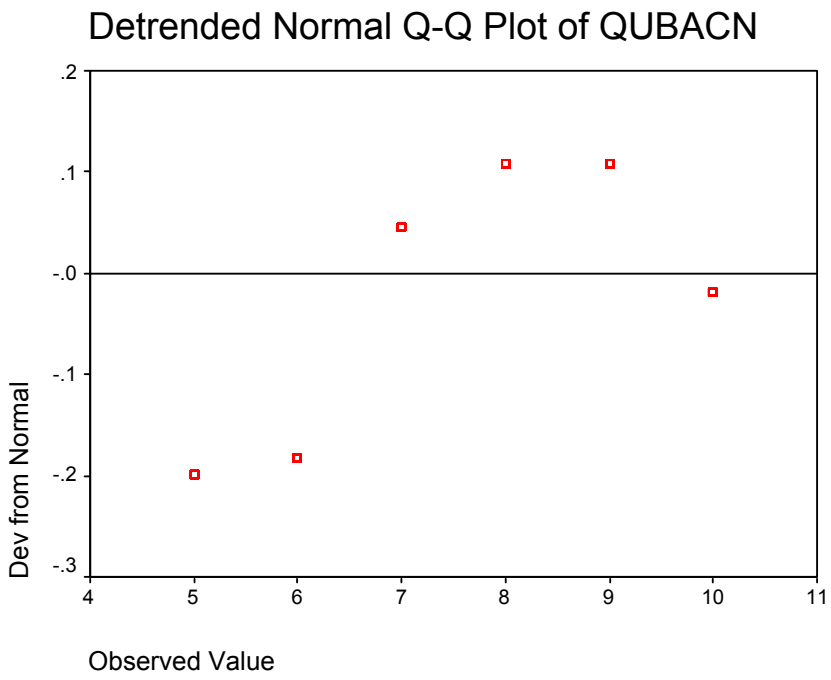

Figure A13. Detrended of chemistry

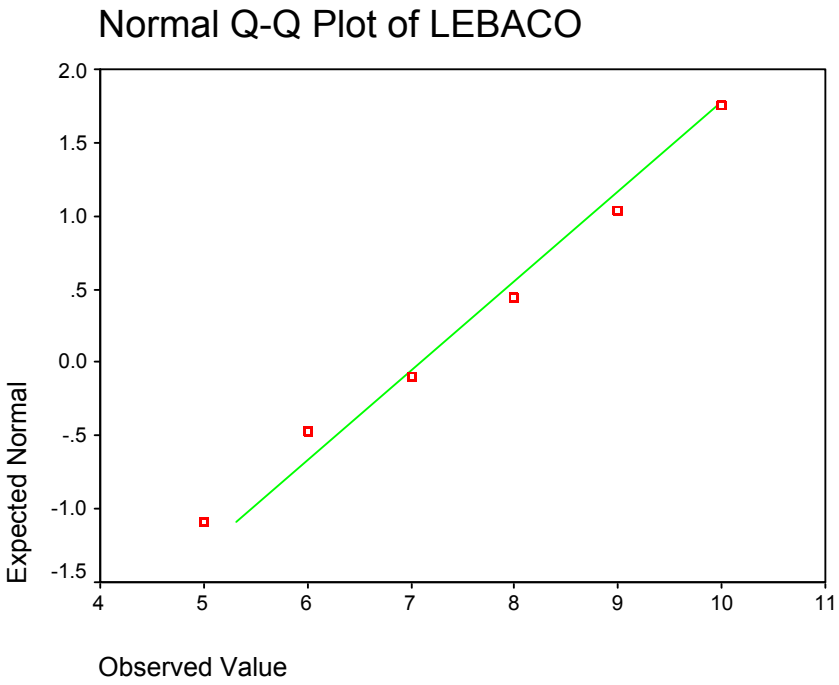

Figure A14. Normal Q-Q plot of reading and verbal and written expression.

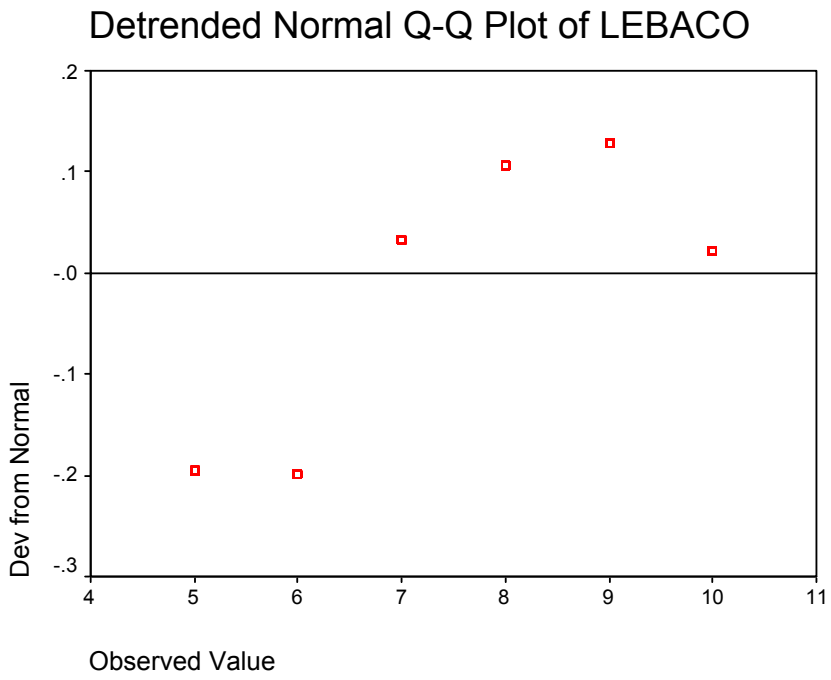

Figura A15. Detrended of reading and verbal and written expression.

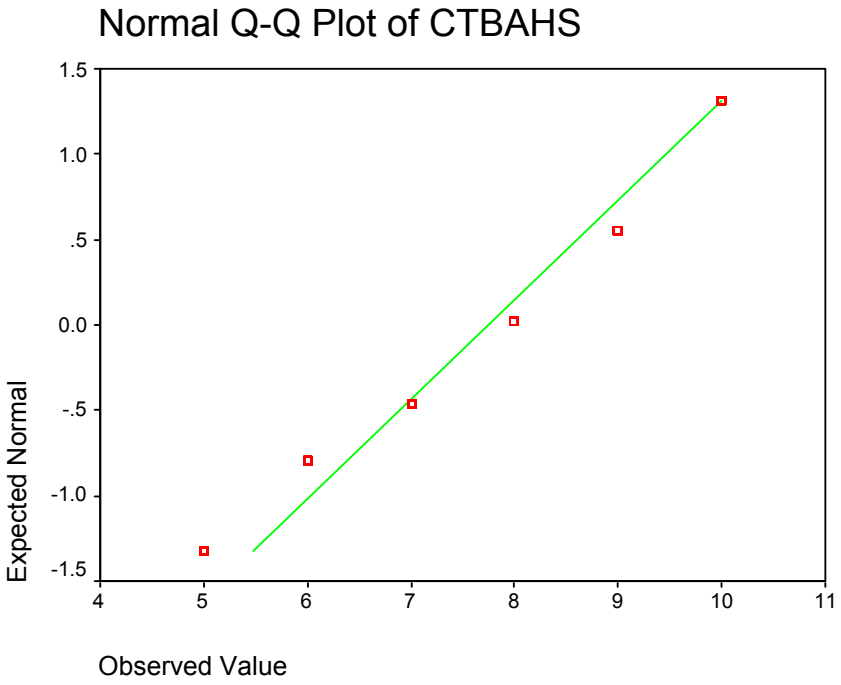

Figura A16. Normal Q-Q plot of science, technologies, society and values.

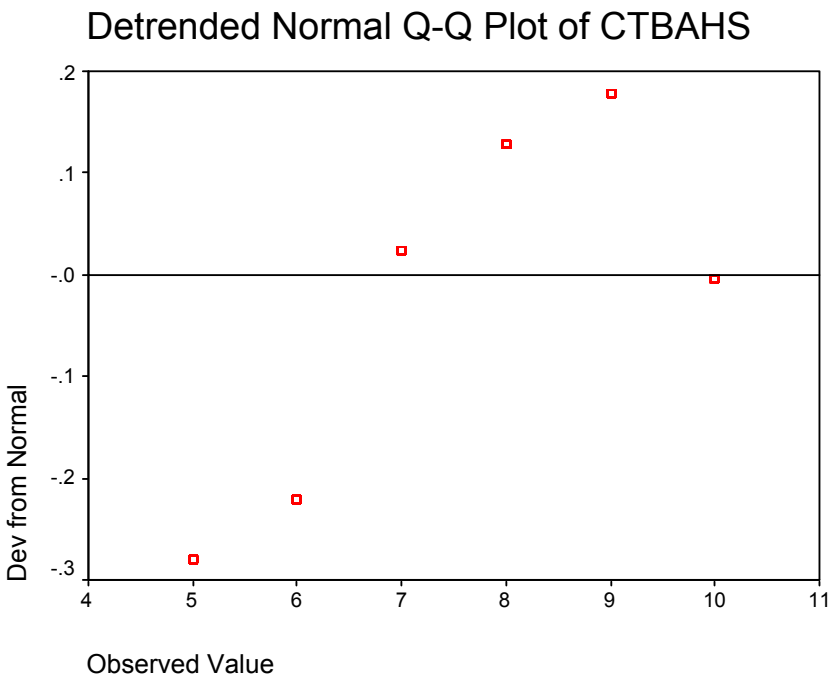

Figure A17. Detrended of science, technologies, society and values.

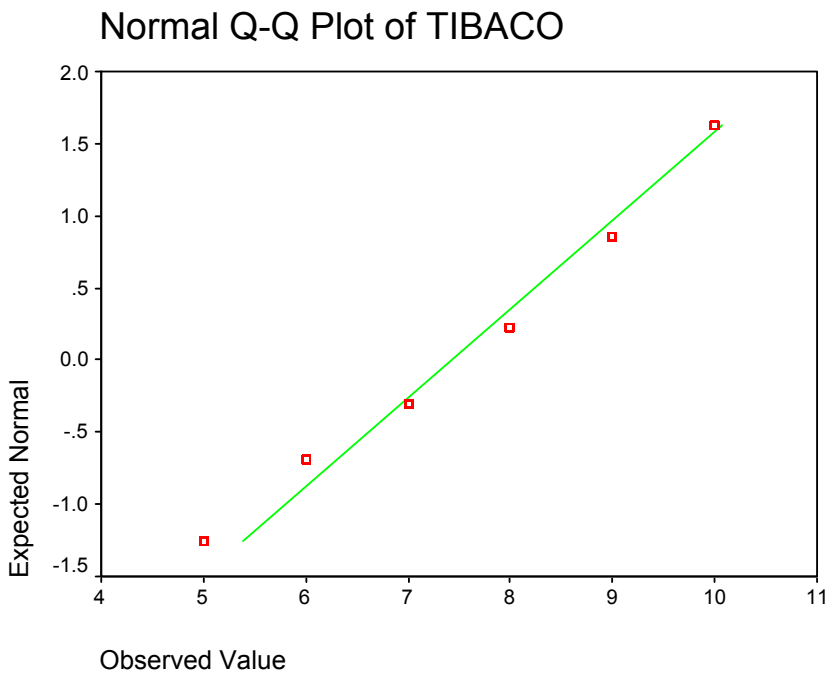

Figure A18. Normal Q-Q plot of TIC

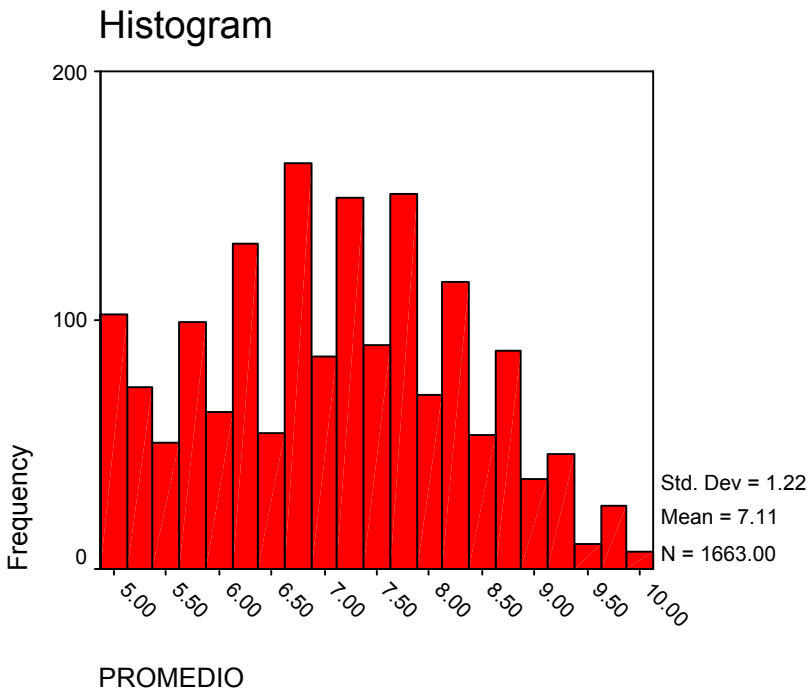

Figura A19. Histograma de variable dependiente. Promedio.

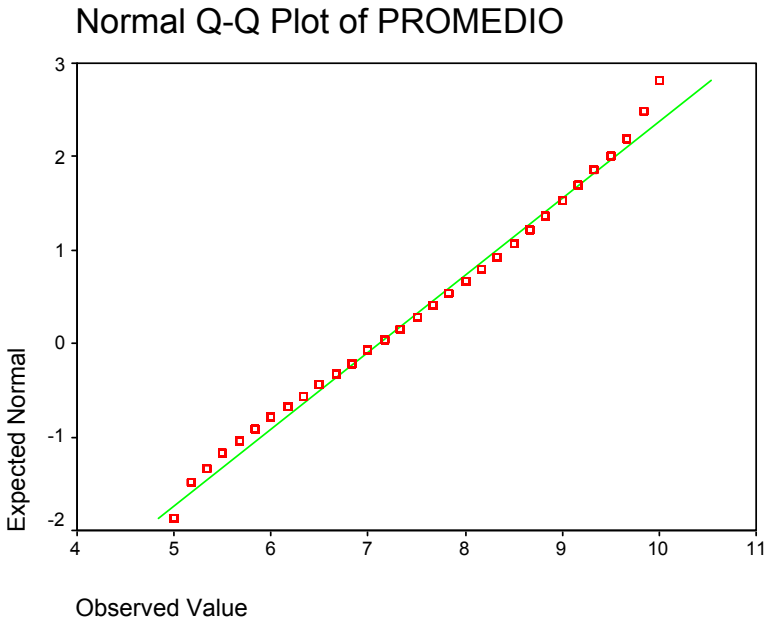

Figure A20. Normal Q-Q plot of GPA

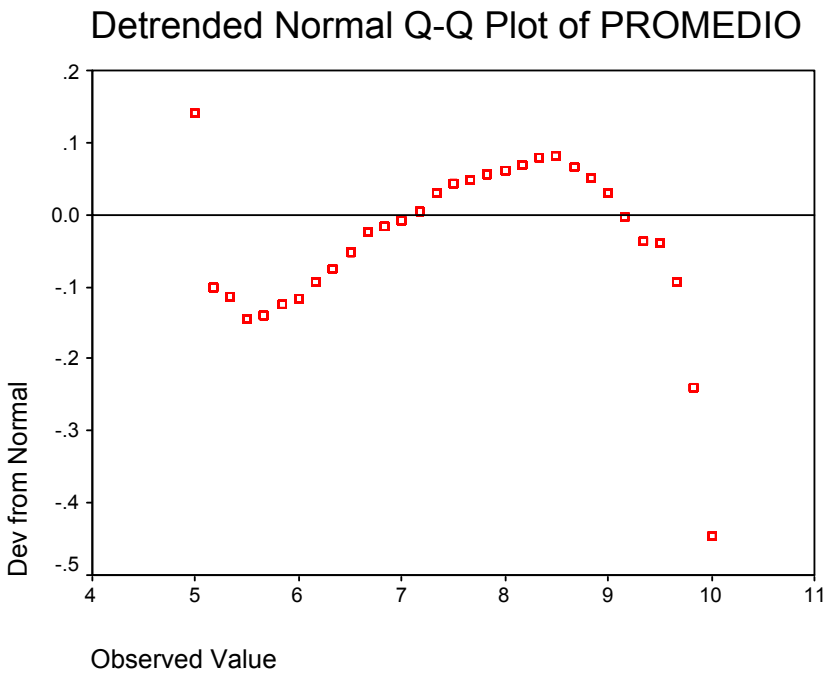

Figure A21. Detrended of GPA

APPENDIX B.

INDEPENDENT VARIABLE

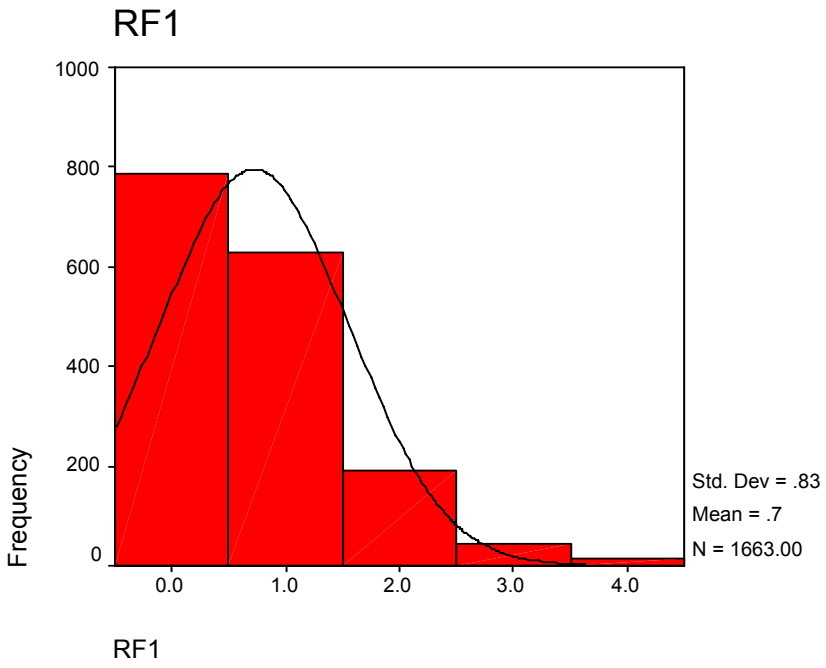

Figure B1. Histogram for *compensaciones multiplicativas*.

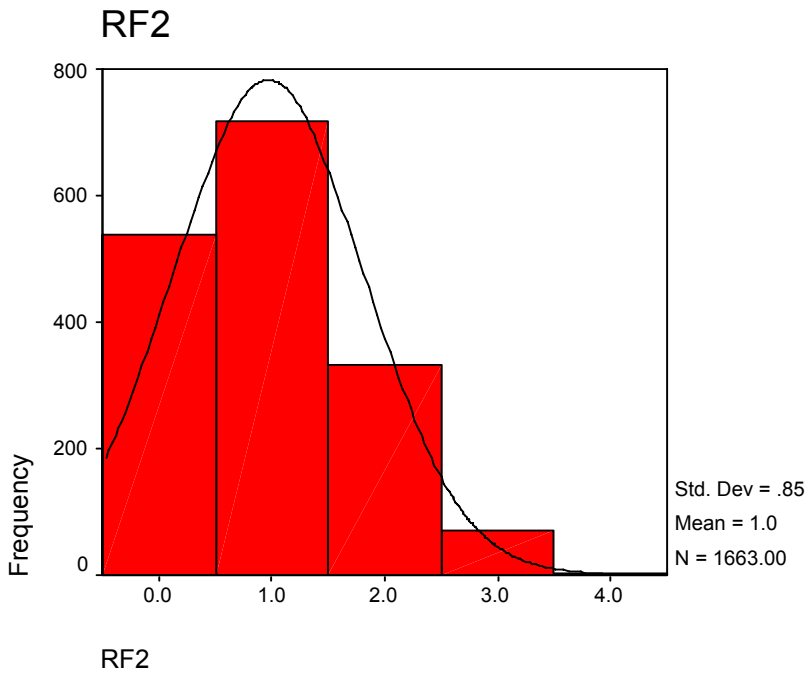

Figure B2. Histogram for *pensamiento correlacional*

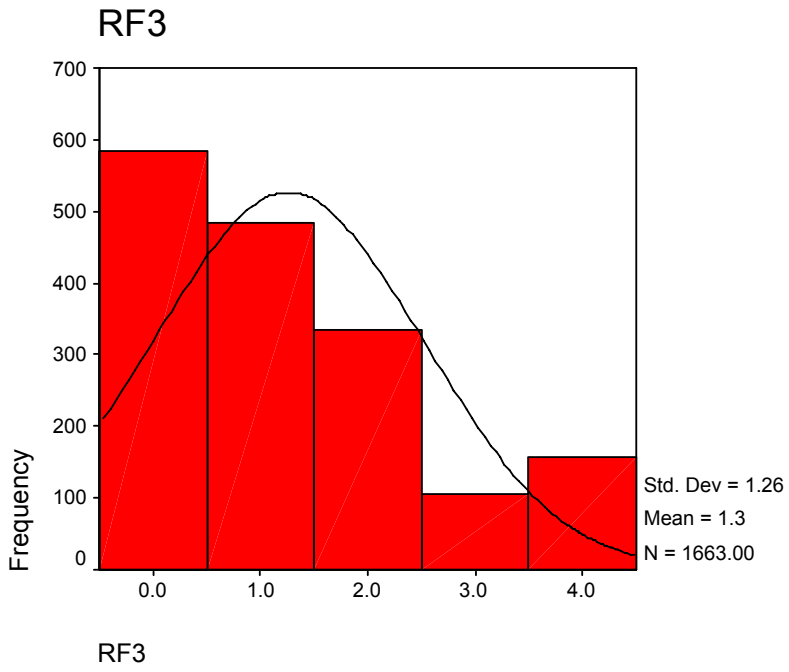

Figure B3. Histogram for *pensamiento probabilistico*.

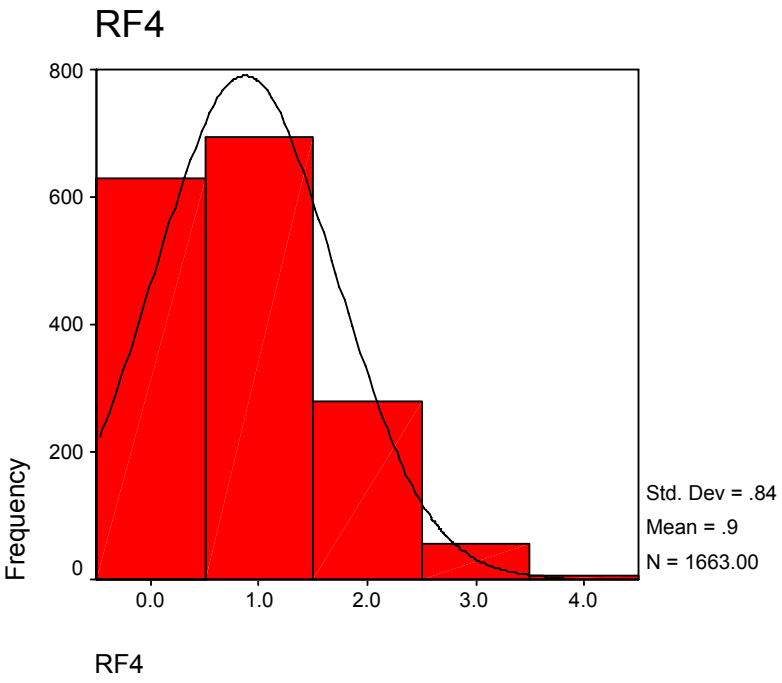

Figure B4. Histogram for *pensamiento combinacional*

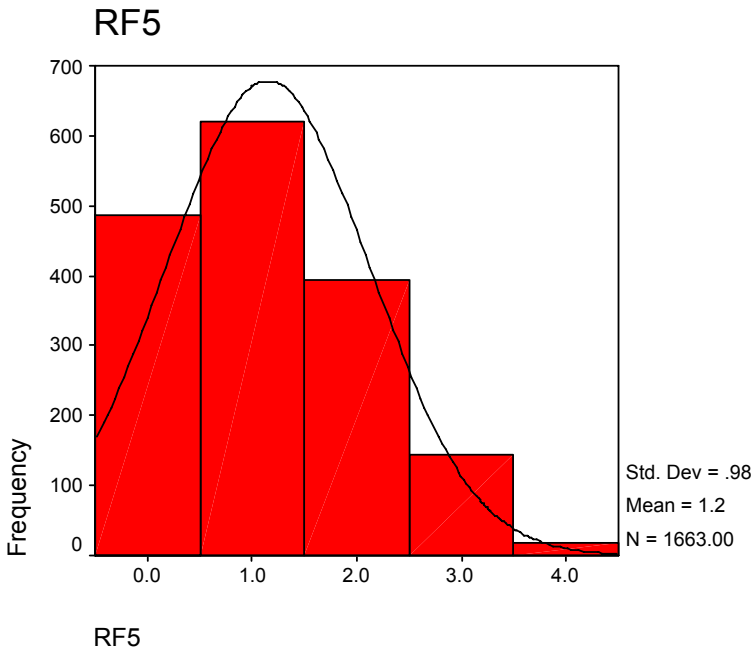

Figure B5 Histogram for *pensamiento proporcional*

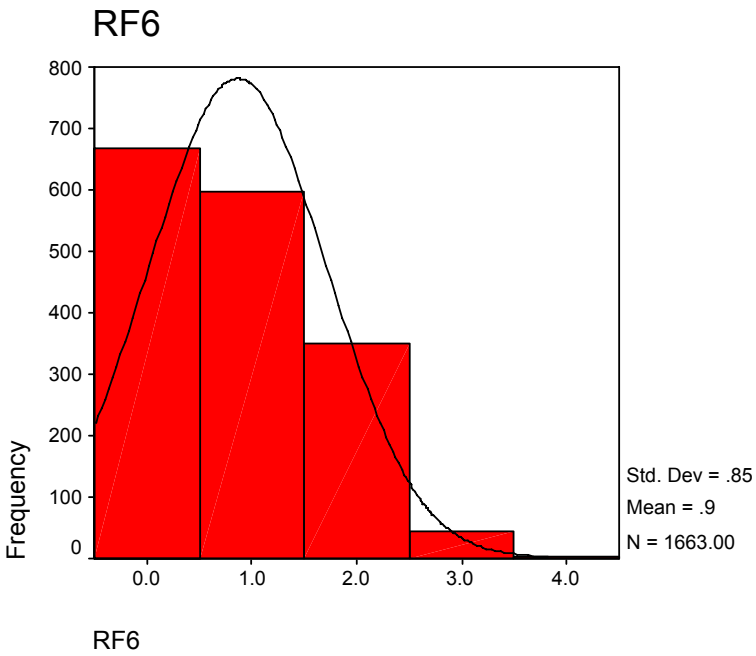

Figure B6. Histogram for *formas de conservación sin verificación directa*

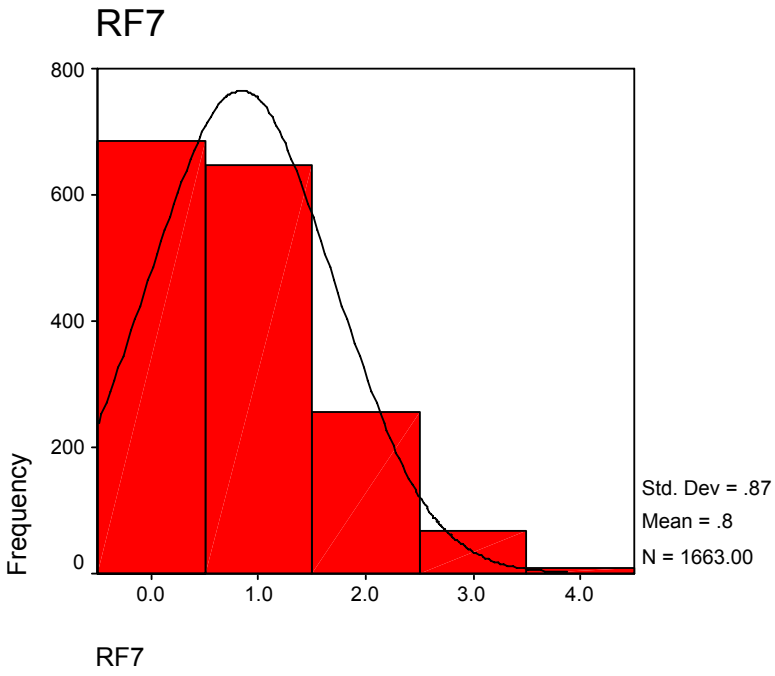

Figure B7. Histograma para *equilibrio mecanico*.

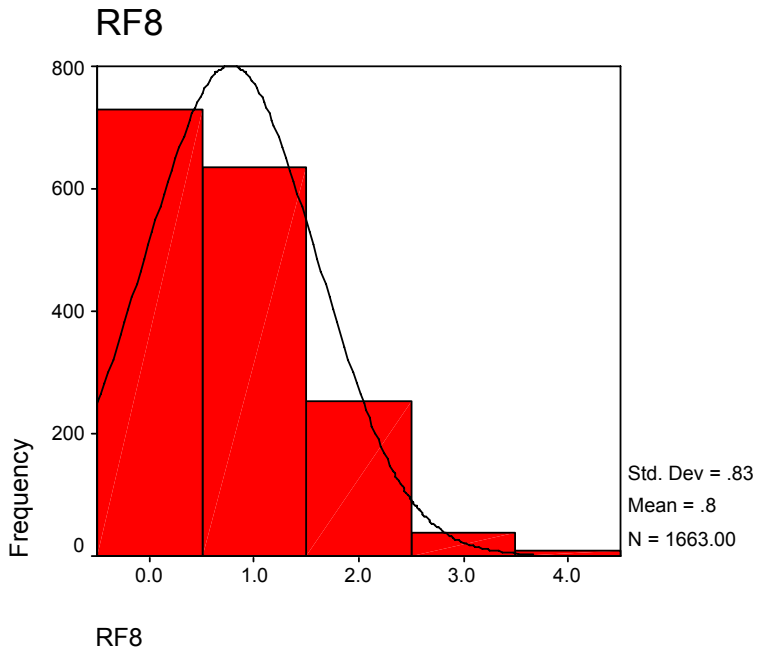

Figure B8. Histograma for *coordinacion de dos o mas sistemas de referencia*

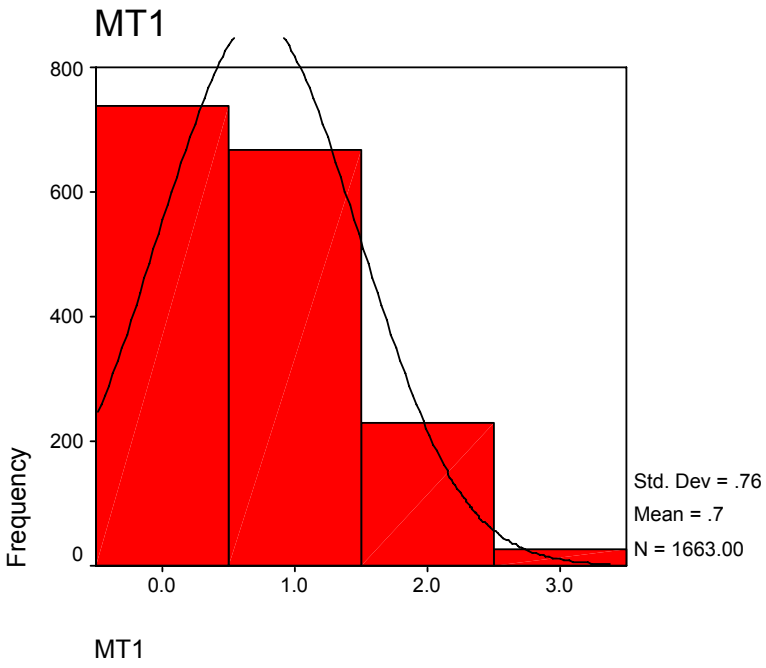

Figure B9. Histogram for *compensaciones multiplicativas*

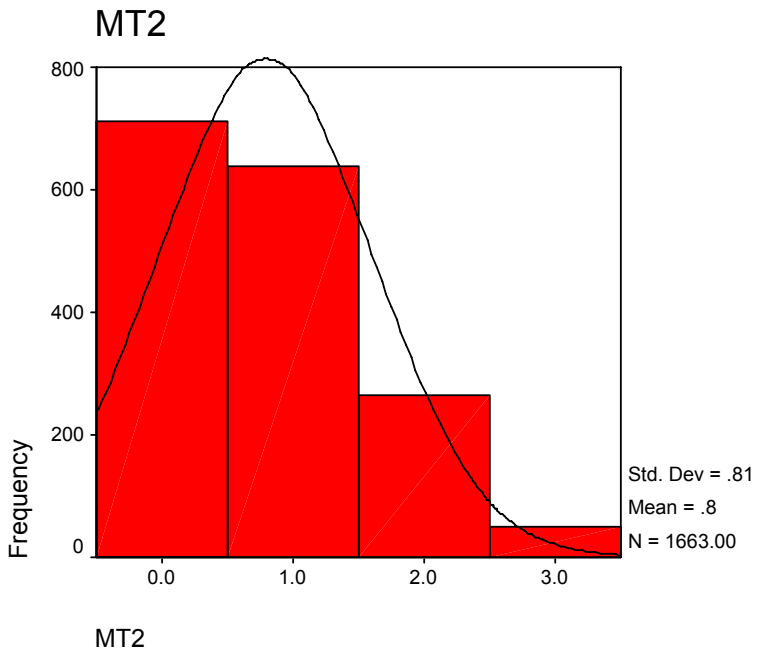

Figure B10. Histogram for capacidad para establecer inferencias lógicas

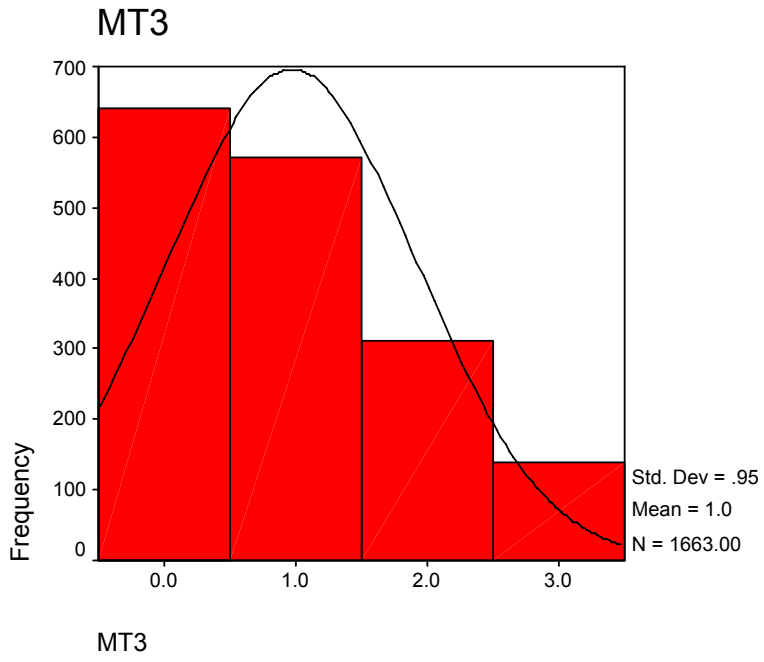

Figure B11. Histogram for *capacidad para realizar generalizaciones*.

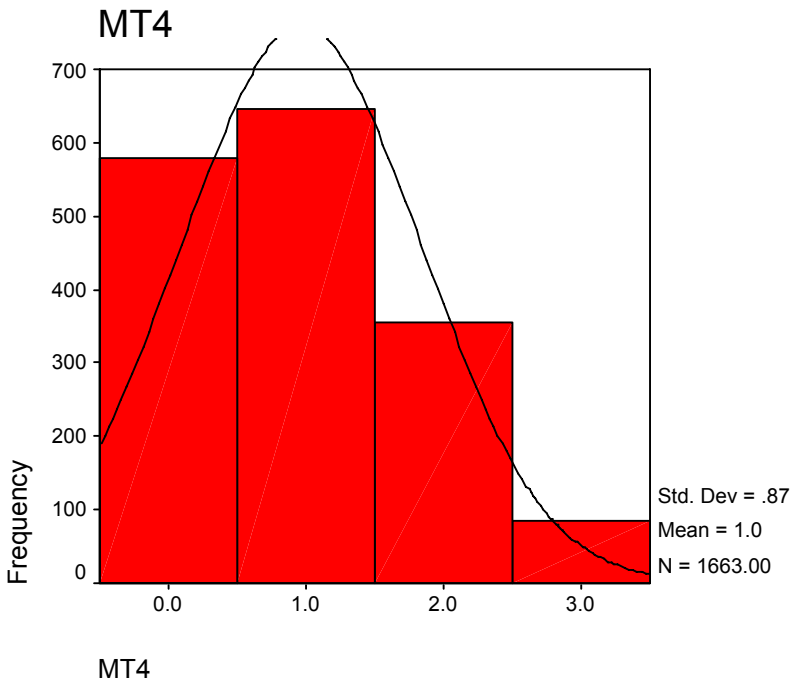

Figure B12. Histogram for *capacidad de abstraccion reflexiva*

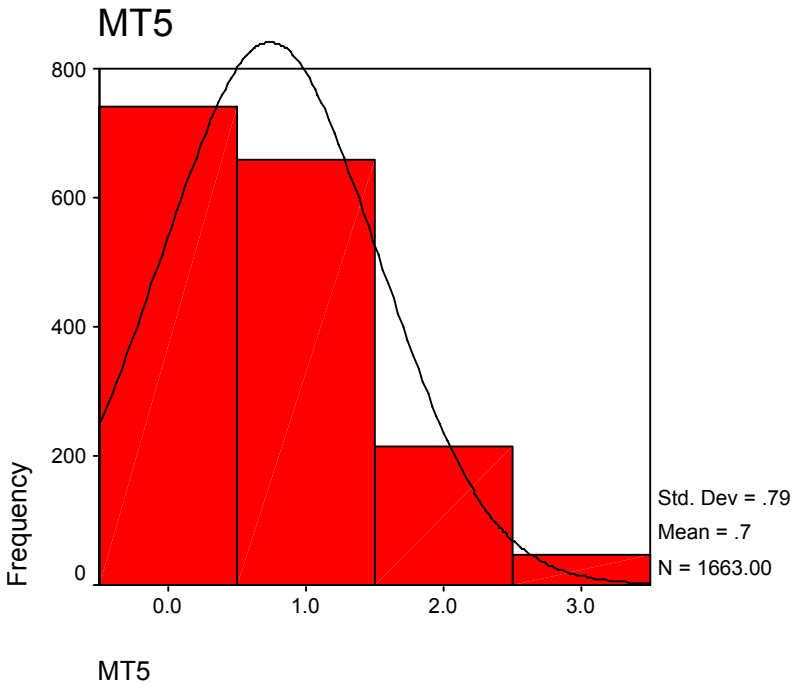

Figure B13. Histogram for *capacidad para establecer relaciones*

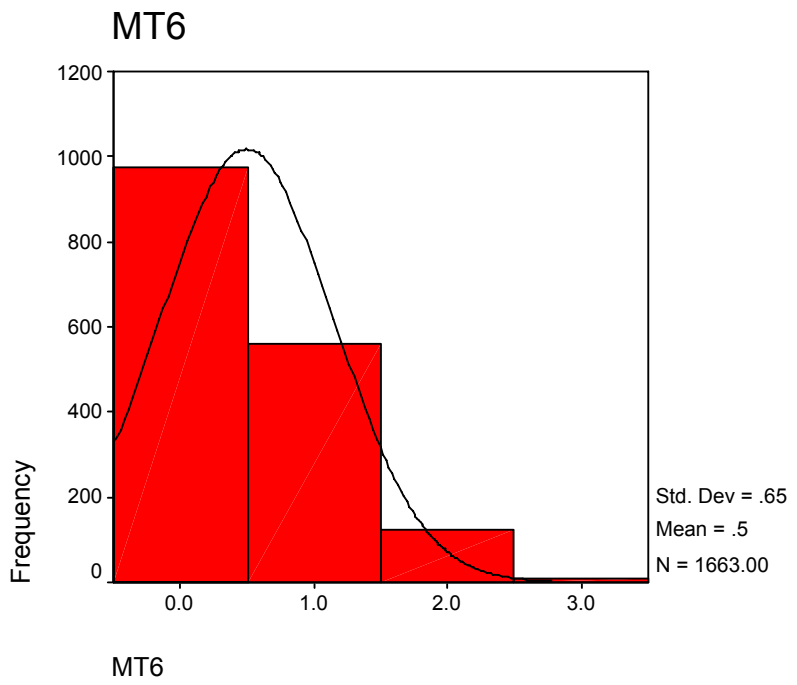

Figure B14. Histogram for *capacidad para comparar relaciones*

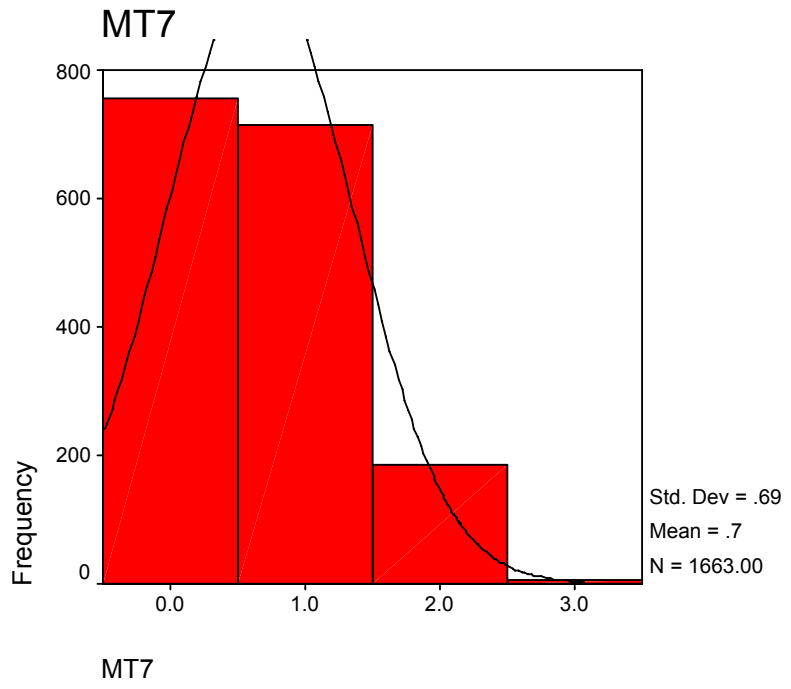

Figure B15. Hitogram for *capacidad de simbolizacion*

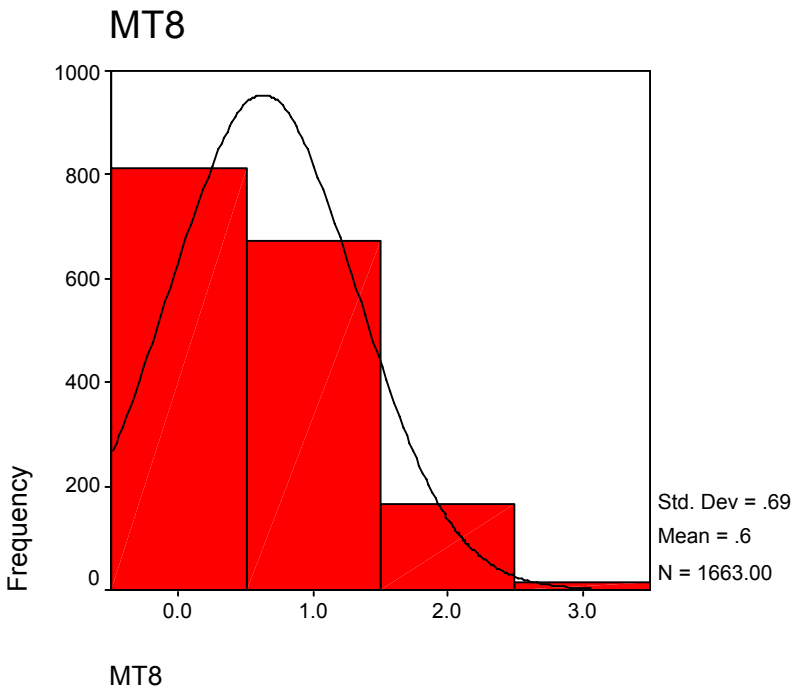

Figure B16. Histogram for *capacidad de imaginacion*

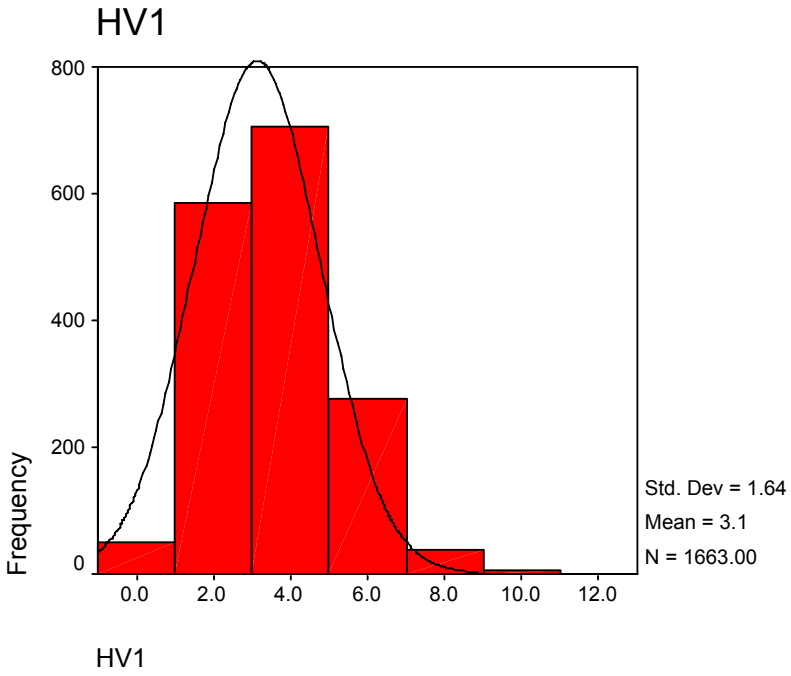

Figure B17. Histogram for *comprension de la lectura*

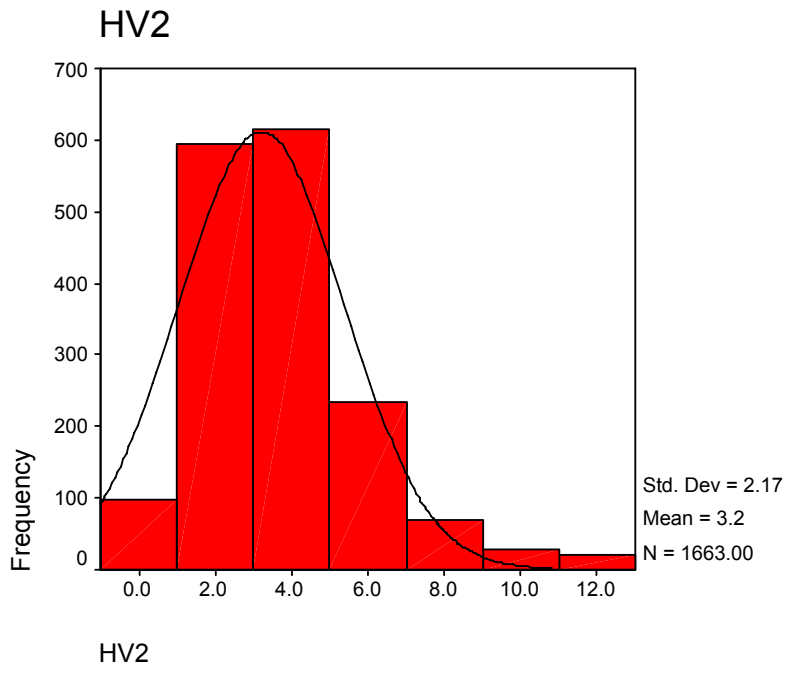

Figure B18. Histogram for *analogias*

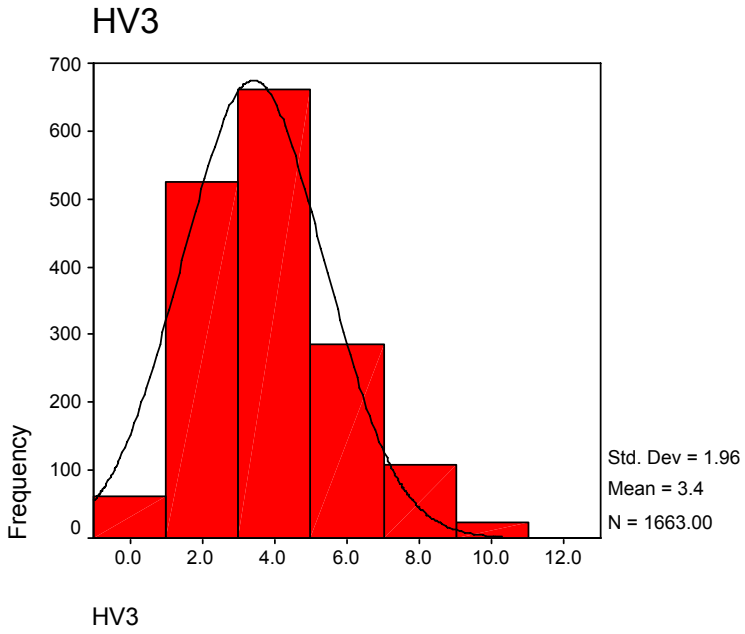

Figure B19. Histogram for complementación de enunciados.

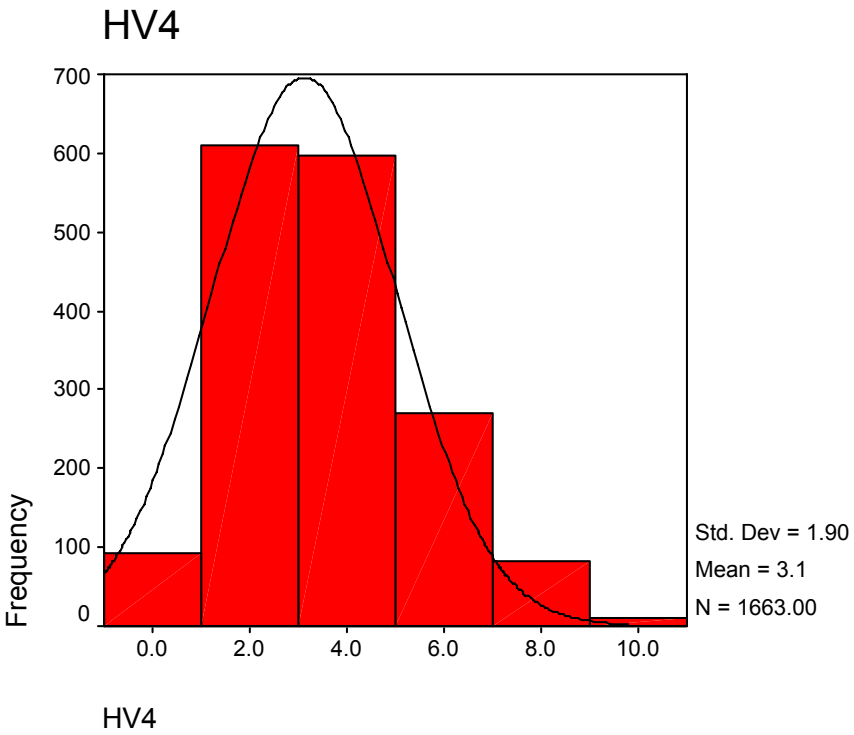

Figure B20. Histogram for *antonimos*

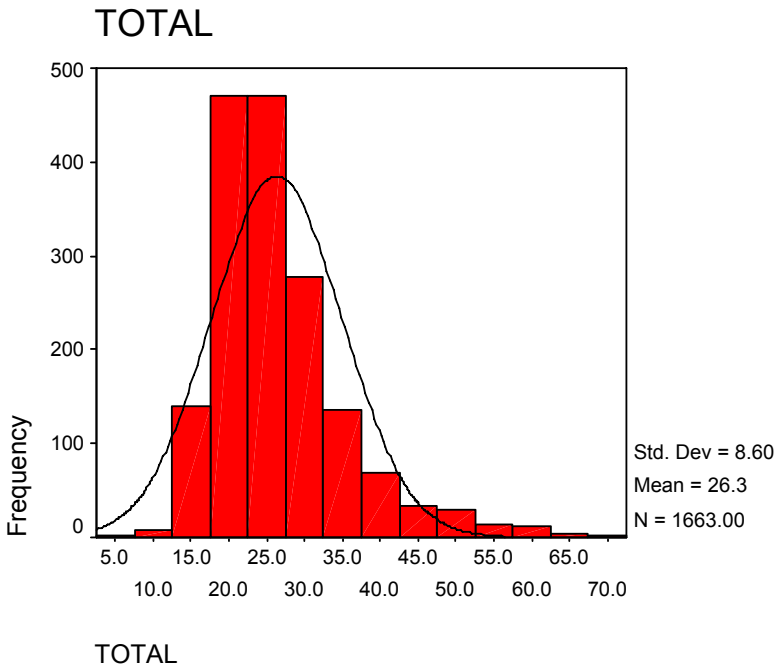

Figure B21. Histogram for *total*

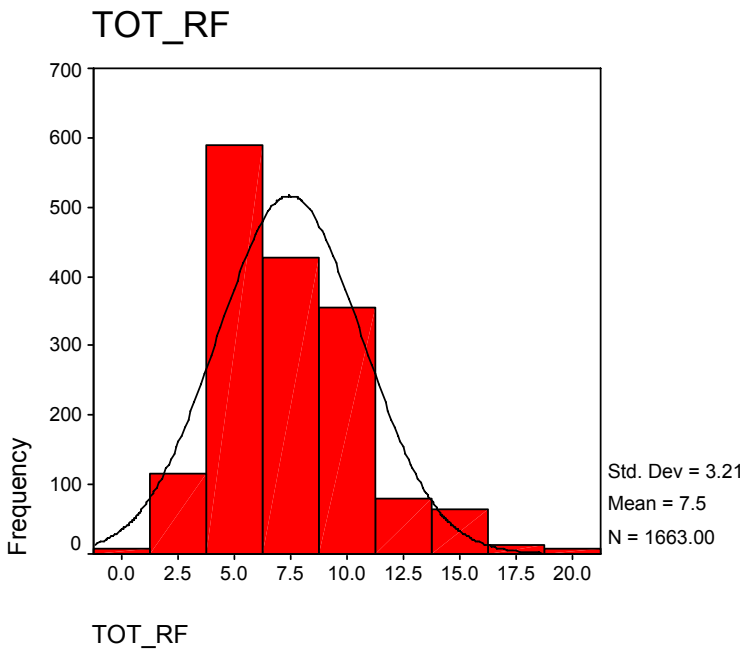

Figure B22. Histogram for sub-total of formal reasoning.

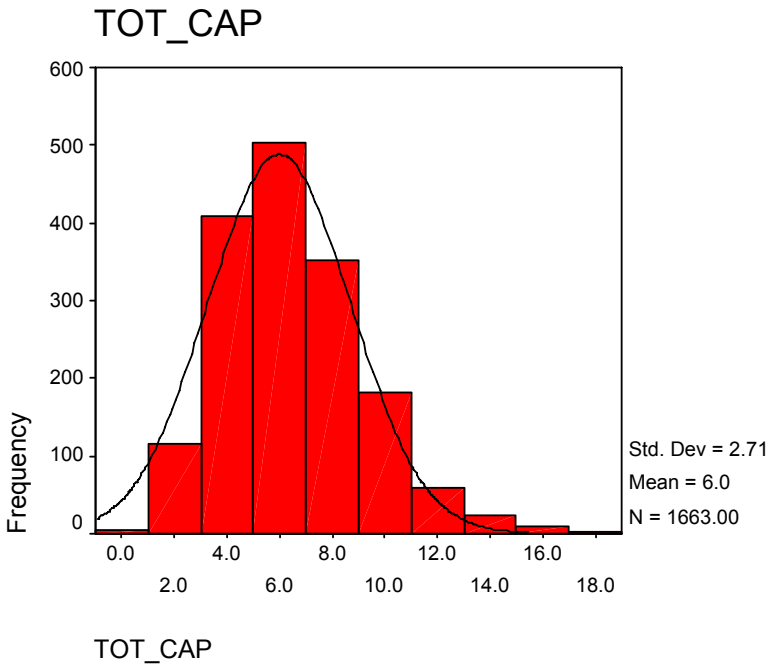

Figure B23. Histogram for sub-total of mathematic abilities

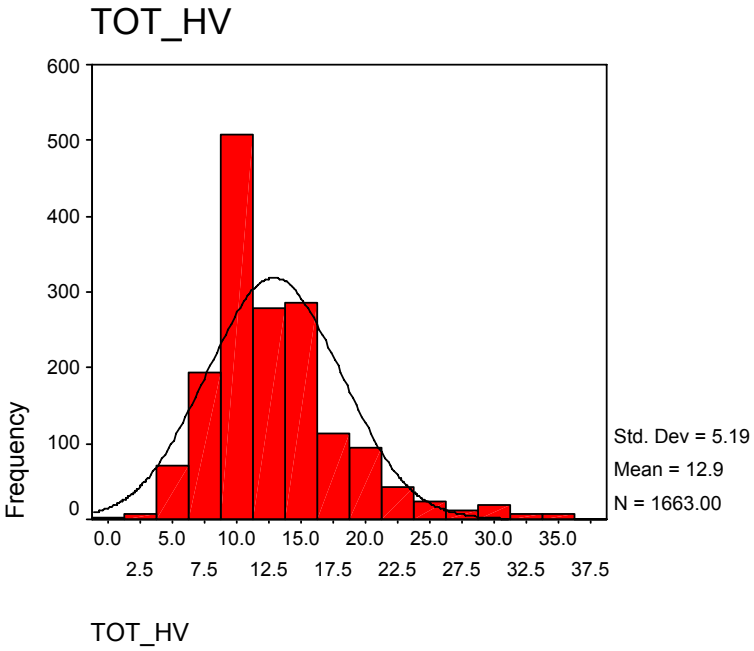

Figure B24. Histogram for sub-total of verbal abilities.

APPENDIX C.

FIGURES C1, C2. AND C3.

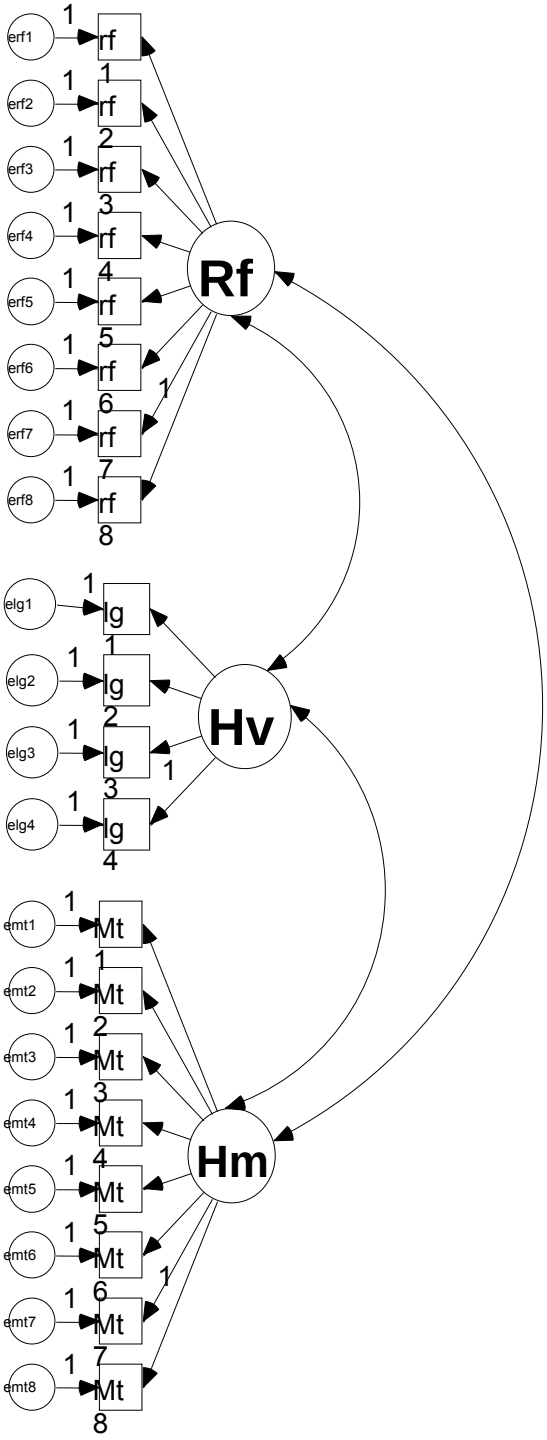

Figure C1. Measurement model to evaluate a tree factor structure

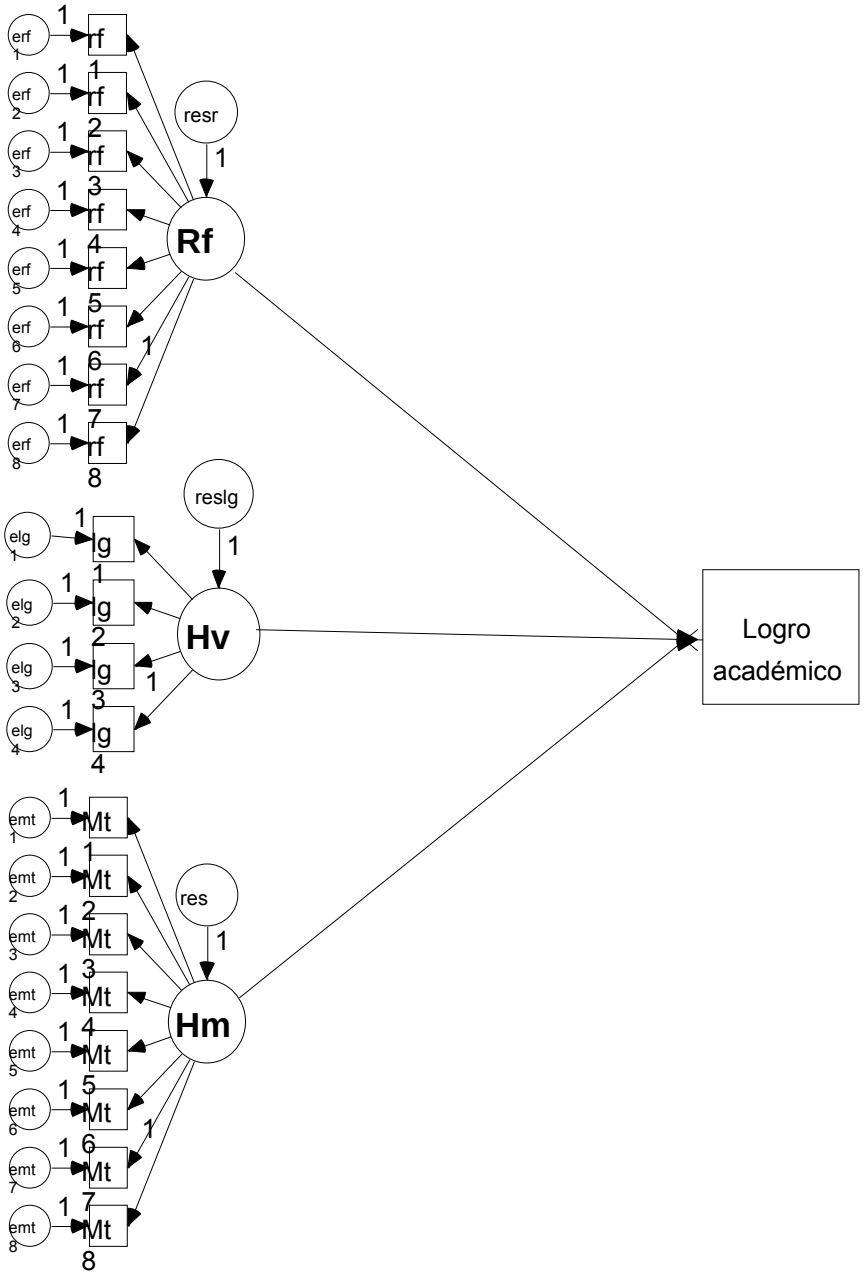

Figure C2. Structure model with depend exogenous manifested variable

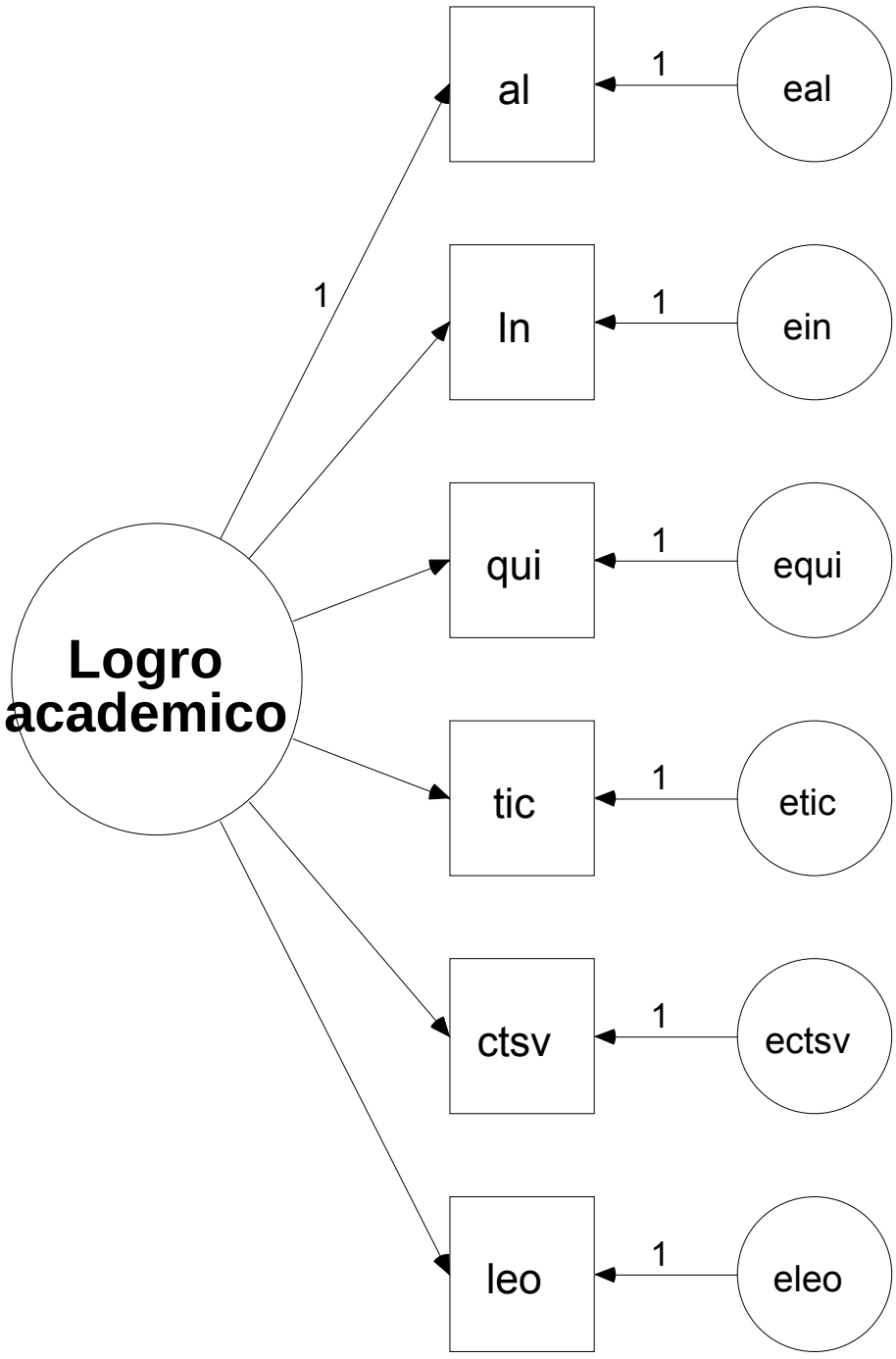

Figure C3. Measurement model of the exogenous latent dependend variable

APPENDIX D.

COSNET TEST.

SECRETARÍA DE EDUCACIÓN PÚBLICA

EVALUACIÓN DEL INGRESO A LA EDUCACIÓN MEDIA SUPERIOR TECNOLÓGICA

CICLO ESCOLAR 2005-2006

EXAMEN DE RAZONAMIENTO FORMAL, CAPACIDADES PARA EL APRENDIZAJE DE LAS MATEMÁTICAS Y HABILIDAD VERBAL

Consejo del Sistema Nacional de Educación Tecnológica

FGC-SUBEV-11

INSTRUCCIONES

Antes de empezar a contestar el examen lee con cuidado las siguientes indicaciones:

1. Este cuadernillo te servirá únicamente para leer las preguntas correspondientes a la examen de Razonamiento formal, Capacidades para el aprendizaje de las Matemáticas y Habilidad verbal, por lo que se te solicita que **no hagas anotaciones ni marcas en él.**

2. Las preguntas contienen cinco opciones de respuesta, indicadas con las letras A, B, C, D y E, siendo **ÚNICAMENTE UNA DE ELLAS LA RESPUESTA CORRECTA.**

3. Deberás registrar tu respuesta en la HOJA DE RESPUESTAS que contiene una serie progresiva de números. Cada número corresponde al número de cada pregunta del cuadernillo, asegúrate de que el **número de pregunta y** de **respuesta coincidan**.

4. Para contestar deberás leer cuidadosamente cada pregunta y elegir la respuesta que consideres correcta.

5. Al contestar cada pregunta, deberás rellenar **SOLAMENTE UNO DE LOS ÓVALOS**, ya que marcar más de uno invalida tu respuesta. No marques hasta que estés seguro de tu respuesta.

6. NO CONTESTES LAS PREGUNTAS AL AZAR, ya que las respuestas incorrectas afectarán tu puntuación. Si no sabes cuál es la respuesta correcta a alguna pregunta, es preferible que no la marques en la hoja de respuestas.

7. Si deseas cambiar de respuesta, puedes hacerlo pero asegurándote de borrar completamente la marca que deseas cancelar, sin maltratar la hoja de respuestas.

8. En cada una de las partes que conforman la examen, se indican los límites de tiempo que tienes para contestar las preguntas de esa parte.

9. Si terminas antes de que se indique que el tiempo ha terminado, podrás repasar las respuestas que has dado. No deberás trabajar en ninguna otra parte de la examen hasta que te sea señalado.

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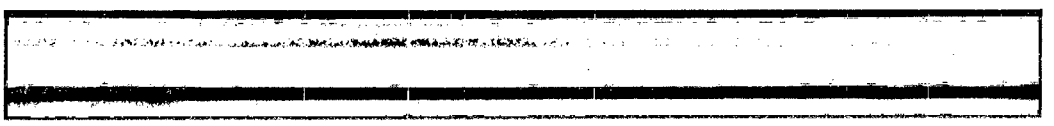

RAZONAMIENTO FORMAL

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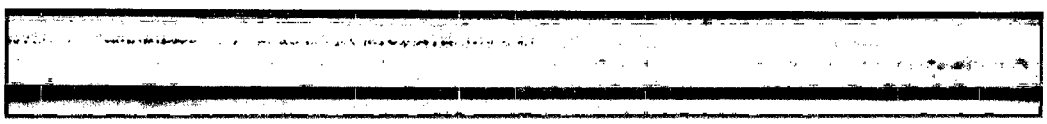
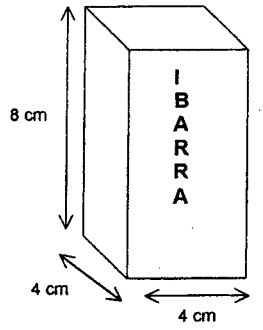


PARTE I

TIEMPO LÍMITE: 60 MINUTOS

1. En la siguiente figura se muestra una barra de mantequilla. ¿Cuál es el volumen de la barra si disminuye un ¼ de su altura?



A) 2 cm^3

B) 32 cm^3

C) 96 cm^3

D) 128 cm^3

E) 512 cm^3

2. ¿Cuál es la explicación de tu respuesta a la pregunta anterior?

A) Al disminuir su altura no cambia el volumen

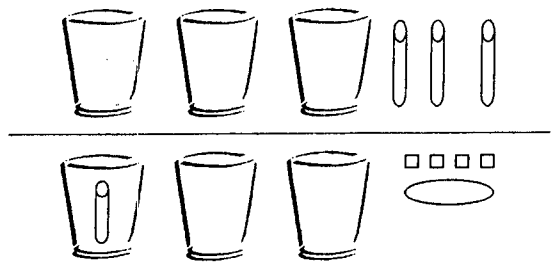
B) El volumen no disminuye proporcionalmente a la altura

C) Al reducir la altura se reduce el volumen proporcionalmente

D) Al disminuir en 4 partes la altura el volumen será la cuarta parte de la barra

E) Al disminuir la dimensión mayor, disminuye consideradamente las otras dos dimensiones

3. Tres vasos (vaso A, vaso B y vaso C) están parcialmente llenos con agua. Junto a los tres vasos, hay 3 barras de plastilina, exactamente del mismo tamaño. La primera barra se coloca en el vaso A, como se muestra en la figura. El nivel del vaso A sube. Antes de colocar la segunda barra de plastilina en el vaso B, se divide en 4 partes. La tercera barra de aplana en forma de tortilla y luego se coloca en el vaso C.



¿Qué crees que sucederá al nivel del agua del vaso B cuando las 4 partes pequeñas de plastilina se coloquen dentro de él?

A) El nivel del agua no subirá tan alto como en el vaso C
B) El nivel del agua subirá más alto que el nivel del vaso C
C) El nivel del agua subirá más alto que el nivel del vaso A
D) El nivel del agua subirá a la misma altura que la del vaso A.
E) El nivel del agua subirá a la cuarta parte de la altura del vaso A

4. ¿Cuál es la razón de tu respuesta anterior?

A) Las 4 barras ocupan menos espacio.
B) La barra aplanada ocupa más superficie
C) Las barra pequeñas ocupan más espacio.
D) Las barras ocupan el mismo espacio no importa la forma
E) Las 4 barras pequeñas pesan lo mismo que la barra grande

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5. El volumen del líquido contenido en un recipiente varía con la temperatura de acuerdo con la siguiente tabla:

TEMPERATURA	VOLUMEN
52°C	100 mm^3
53°C	109 mm^3
55°C	127 mm^3
57°C	145 mm^3

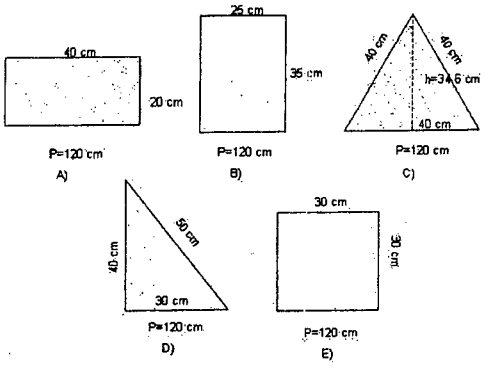
¿Cuál será el volumen del líquido cuando la temperatura sea de 62°C ?

A) 154 mm^3
B) 172 mm^3
C) 190 mm^3
D) 200 mm^3
E) 271 mm^3

6. ¿Cuál es la razón de tu respuesta a la pregunta anterior ?

A) El volumen del líquido crece en potencias de 9
B) El volumen del líquido se duplica por cada grado
C) El aumento del volumen equivale al aumento de la temperatura
D) El aumento en la temperatura es igual al aumento del volumen del líquido
E) El incremento de la temperatura es directamente proporcional al aumento de volumen

7. En un catálogo se exhiben ciertos modelos de ventanas como se muestra. ¿Cuál será la ventana que permite penetrar más luz a una habitación?



8. ¿Cuál es la razón de tu respuesta a la pregunta anterior?

A) Porque tiene la mayor superficie
B) Porque la altura es la más grande de todas
C) Por que uno de sus lados es el más grande de todos
D) Porque tiene compensada en forma proporcional su base y su altura
E) Porque la forma de la ventana es la que afecta la penetración de la luz

9. ¿ Cuál es la probabilidad de obtener un siete, al tirar dos dados una sola vez?

A) $\frac{1}{36}$
B) $\frac{1}{3}$
C) $\frac{1}{2}$
D) $\frac{1}{6}$
E) $\frac{2}{7}$

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10. ¿Cuál es la razón de tu respuesta a la pregunta anterior?

A) Existen seis combinaciones cuya suma es siete
B) Existen doce combinaciones al tirar los dos dados
C) Son dos dados para obtener en suma el valor siete
D) Por que es un número el que se quiere, para dos dados
E) Los seis números de un dado tienen la misma probabilidad

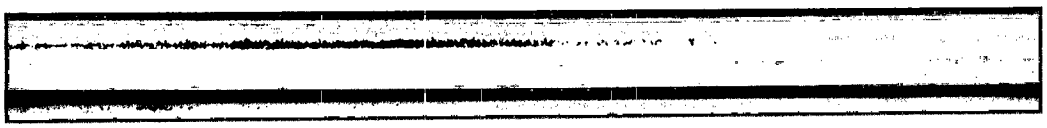
11. Dentro de un saco negro se tienen 30 monedas de $20.00, 40 monedas de $10.00 y 50 monedas $5.00. Se te pide que saques del saco una moneda al azar.

¿ Cuál será tu probabilidad de sacar una moneda de $10.00 en un solo intento?

A) Un éxito de cada tres intentos
B) Un éxito de cada ocho intentos
C) Un éxito de cada cuatro intentos
D) Un éxito de cada cuarenta intentos
E) Un éxito de cada ciento veinte intentos

12. ¿Cuál es la explicación de tu respuesta a la pregunta anterior?

A) Mi probabilidad se fundamenta en que solo hay tres tipos de monedas
B) Mi probabilidad se fundamenta en que tengo que sacar una moneda de $10.00 de un total de 40
C) Mi probabilidad se fundamenta en que debo sacar una moneda de $10.00 de un saco de 120 monedas
D) Mi probabilidad se fundamenta en relacionar el número de monedas que no son de $10.00 con el total de monedas
E) Mi probabilidad se fundamenta en relacionar el número de monedas de $10.00 con el total de monedas en el saco



13. Una fuente de sodas tiene tres tipos de pan y seis tipos de alimentos. ¿Cuántos sandwichs diferentes puede preparar?

A) 2
B) 3
C) 6
D) 9
E) 18

14. ¿Cuál es la razón a la respuesta anterior?

A) Es la combinación de los tipos de pan con los tipos de alimento.
B) Es el máximo de alimentos que se le pueden poner a un pan.
C) Para cada tipo de pan se utiliza un tipo de alimento.
D) Son el total de alimentos para los tipos de pan.
E) Son el total de insumos que se tienen.

15. Una dama tiene en su closet tres tipos de prendas en las siguientes cantidades: dos blusas, tres faldas y cinco pares de zapatos. ¿Cuántas son las posibles combinaciones que puede hacer con ese guardarropa?

A) 3
B) 10
C) 13
D) 30
E) 60

16. ¿Cuál es la explicación de tu respuesta a la pregunta anterior?

A) Se suma el numero de prendas
B) Se multiplica el número de prendas
C) Se consideran solo la cantidad de tipos de prenda
D) Es el total de prendas más la cantidad de tipos de prenda
E) Se multiplican las prendas considerando que son 10 zapatos

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17. Las tortugas depositan un promedio de 120 huevos. De los cuales brotan 96, ¿qué porcentaje se pierde?

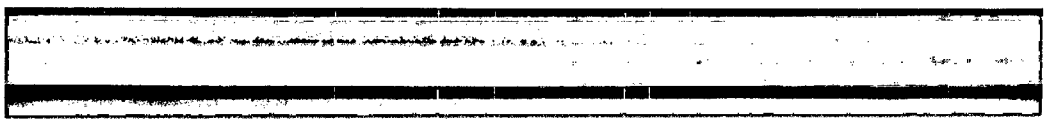
A) 500%
B) 125%
C) 80%
D) 25%
E) 20%

18. ¿Cuál es la explicación de tu respuesta a la pregunta anterior, si x representa los huevos perdidos?

A) La cantidad de huevos es a 100 como la cantidad de huevos perdidos es a x
B) El total de huevos depositados es a 100 como la cantidad de huevos perdidos es a x
C) La cantidad de huevos depositados es a la cantidad de huevos que brotan como 100 es a x
D) La cantidad de huevos perdidos es la cantidad de huevos depositados como 100 es a x
E) La cantidad de huevos perdidos x es a 100 como huevos depositados es a huevos que brotan

19. El precio de venta de cierto artículo el año pasado fue de $600.00. Este año subió a $800.00. ¿ Qué porcentaje aumento ?

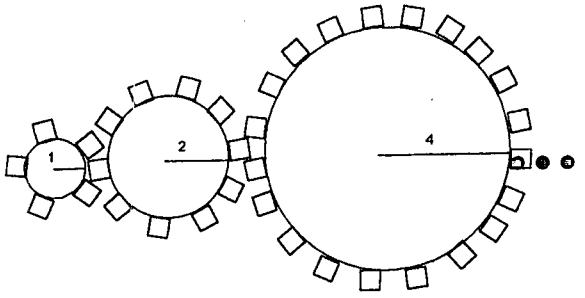
A) 25%
B) 30%
C) 33%
D) 75%
E) 175%



20. ¿Cuál es la explicación de tu respuesta a la pregunta anterior?

A) Es la diferencia con respecto al precio del año anterior
B) Es la diferencia con respecto al precio del año actual
C) Es la suma con respecto al precio del año actual
D) Es el precio del año actual entre el año anterior
E) Es el precio del año anterior entre el año actual

21. Se colocan 5 engranes en la forma que se muestra la figura, cuyos radios son de 1,2,4,8 y 16. Se sabe que el primero de los engranes gira a una velocidad de 32 revoluciones por minuto, ¿Cuál será la velocidad del quinto engrane?



A) 1
B) 2
C) 18
D) 32
E) 512

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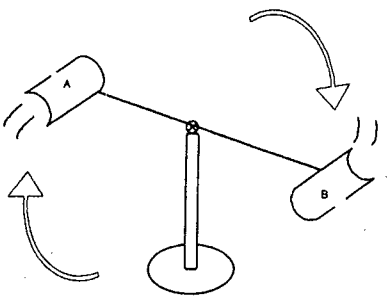
22. ¿Cómo justificas tu respuesta?

A) La velocidad se duplica en cada engrane
B) La velocidad aumenta tanto como los radios
C) La velocidad no se afecta por ser más grande
D) Le velocidad se reduce a la mitad en cada engrane
E) La velocidad se reduce al mínimo por ser el último engrane

23. El juego representado en la siguiente figura, gira libremente sobre un eje central.



¿Qué sucederá al juego si colocamos el mismo peso en cada uno de los platillos A y B y aplicamos una fuerza que lo haga girar?

A) La velocidad de giro se mantendrá constante siempre
B) La velocidad de giro irá disminuyendo poco a poco hasta que los platillos queden en equilibrio
C) La velocidad de giro irá aumentando conforme pase el tiempo
D) El juego dará una sola vuelta y quedará en completo equilibrio horizontal
E) El juego dará una sola vuelta y quedará en completo equilibrio vertical

24. ¿Cuál es la explicación de tu respuesta a la pregunta anterior?

A) La velocidad de ascenso del platillo A es siempre igual a la velocidad de descenso del platillo B

B) La fuerza de gravedad impide al juego girar y por eso se detiene pronto

C) El juego se detendrá poco a poco debido a la resistencia del aire

D) Como los pesos en ambos platillos son iguales se detendrá a la primera vuelta

E) El juego se equilibra, en la dirección de la fuerza de gravedad por causa de la misma

25. Padre e hijo dan un paseo en bicicleta. El radio de la rueda de la bicicleta del hijo es tres veces menor que la del papá. Si medimos el esfuerzo realizado por ambos como la razón del número de vueltas de la rueda de la bicicleta del hijo al número de vueltas respectivamente del papá; ¿qué esfuerzo necesita hacer el hijo para no rezagarse?

A) 2 veces más

B) 3 veces más

C) 4 veces más

D) 6 veces más

E) 9 veces más

26. Tu respuesta; ¿Con qué razonamiento la justificas?

A) Porque el esfuerzo depende de la razón de los radios elevada al factor que nos dá la longitud de la rueda

B) Porque el esfuerzo depende de la diferencia entre las longitudes de las ruedas

C) Porque el esfuerzo depende de la razón de los radios por el número de ruedas

D) Porque el esfuerzo depende únicamente de la razón de los radios

E) Porque el esfuerzo depende de la longitud de la rueda

27. Un hombre tiene una tabla que mide 6mts. y tiene el punto de apoyo a la mitad, cuenta con tres pesas de 6 kg., 4 kg. y 3 kg. y las pesas más grandes van en los extremos. ¿Qué debe hacer para poner la tabla horizontalmente?

A) Debe poner la pesa en el extremo donde está la de 4 kg.
B) No importa donde ponga la pesa ya no afecta.
C) Debe poner la pesa a 1 m del punto de apoyo.
D) Debe ponerla a 2 m del punto de apoyo.
E) No debe poner la pesa.

28. ¿Cuál es la razón de tu respuesta a la pregunta anterior?

A) Es lo más cercano al punto de apoyo.
B) Si se conjuntan las pesas en un punto se nivela la tabla.
C) Con las dos pesas grandes es suficiente para equilibrar la tabla.
D) No se puede equilibrar la tabla porque las pesas no son suficientes.
E) Es la distancia que equilibra el peso considerando las otras distancias y las pesas.

29. Un avión nodriza surte de combustible a un avión caza en pleno vuelo, a través de un tubo, la velocidad que tienen es de 360 km/h. Al separarse el avión caza sale con 120 km/h más de la velocidad que tenía, si continúa la misma trayectoria que el avión nodriza durante 30 min. ¿A qué distancia estará el avión caza del avión nodriza? Si se sabe que la velocidad es lo que el avión recorre en el tiempo de observación.

A) 60 km
B) 105 km
C) 180 km
D) 240 km
E) 420 km

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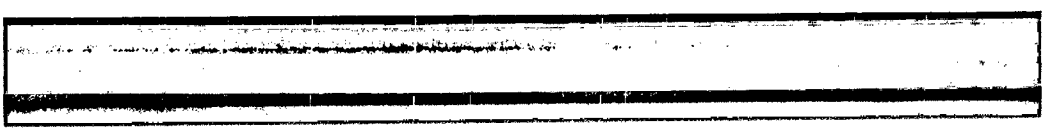
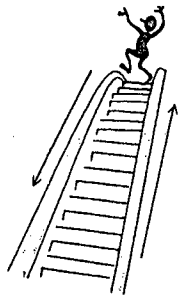


30. ¿Cuál es la razón de tu respuesta a la pregunta anterior?

A) Es el promedio de las distancias recorridas.
B) Es lo que recorre a la velocidad promedio de los 2 aviones.
C) Lo que recorrió el avión caza a la velocidad de los 2 aviones
D) La distancia recorrida a la diferencia de las velocidades de los aviones.
E) Lo que recorrieron ambos aviones quitando lo que recorrió el avión caza.

31. Un niño juega en una escalera eléctrica de 20m de largo que se mueve hacia arriba a una velocidad de 20 m/min, ¿a qué velocidad debe bajar el niño para llegar al pie de la escalera en medio minuto?

A) 80 m/min
B) 60 m/min
C) 40 m/min
D) 20 m/min
E) 10 m/min



32. La justificación a tu respuesta a la pregunta anterior es:

A) Existe una proporción directa entre la velocidad y el tiempo
B) Existe una proporción indirecta entre la velocidad y el tiempo
C) La velocidad del niño y la de la escalera debe ser la misma para compensar
D) La velocidad del niño debe duplicar la velocidad de la escalera y el recorrido en 1 minuto
E) La velocidad tiene que compensar la velocidad de la escalera y el recorrido en el tiempo indicado

DETENTE

SI TERMINAS ANTES QUE SE TE INDIQUE, REPASA ÚNICAMENTE ESTA SECCIÓN. NO TRABAJES EN OTRAS PARTES DEL EXAMEN

CAPACIDADES PARA EL APRENDIZAJE DE LAS MATEMÁTICAS

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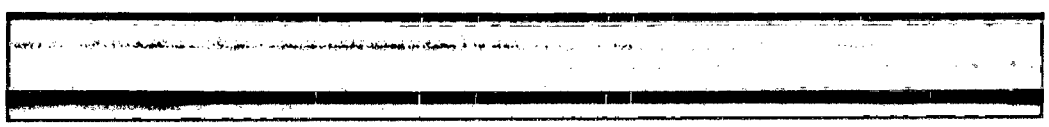


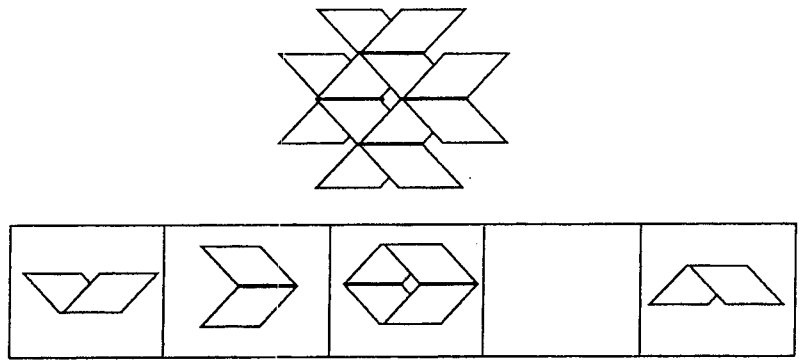
PARTE II

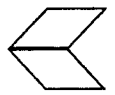
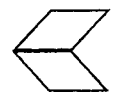
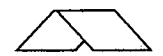
TIEMPO LÍMITE: 40 MINUTOS

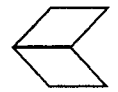
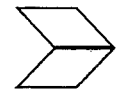
33. Si consideras que a,b,c y d son número naturales, donde a>b y c<b, ¿qué sucede si sumas d, a los elementos particulares en ambas afirmaciones de la desigualdad?

A) a<b y c<b
B) a=b y c=b
C) a>b y c<b
D) a=b y c>b
E) a<b y c>b

34. Observa la siguiente figura y selecciona la que complete la serie:



A 
B 
C 

D 
E) 

35. El cociente que resulta de dividir el doble de un número entre el cuadrado del mismo número puede simbolizarse:

A) $\frac{2x}{y^2}$

B) $\frac{2x}{x^2}$

C) $\frac{x^2}{2y}$

D) $\frac{x^2}{2x}$

E) $\frac{2x^2}{x}$

36. Alberto tiene hermanos y hermanas, sus hermanas son la mitad de los hermanos que son. ¿Cuál es la expresión que representa el número de hombres y de mujeres?

A) $h = 2m \qquad m = \frac{h+1}{2}$

B) $h = \frac{m+1}{2} \qquad m = \frac{h+1}{2}$

C) $h = \frac{m}{2} \qquad m = 2h$

D) $h = \frac{m-1}{2} \qquad m = \frac{h}{2} - 1$

E) $h = 2m \qquad m = \frac{h}{2}$

37. Si A>B, B>R, y a su vez D>R y B, pero menor que A, entonces la escala correcta de ubicación de A, B, R y D de mayor a menor es:

mayor → menor

A) | D | A | B | R |

B) | A | B | D | R |

C) | R | B | D | A |

D) | A | D | R | B |

E) | A | D | B | R |

38. Una planta aumenta en peso y tamaño de acuerdo con la siguiente tabla:

Peso en gramos (p)	Longitud en centímetros (L)
20	15
35	22.5
40	25
50	30

¿Qué relación peso-longitud describe su comportamiento?

A) L=p-5

B) $L=\frac{1}{2}p+5$

C) $L=\frac{3}{4}p$

D) $L=\frac{1}{2}p-5$

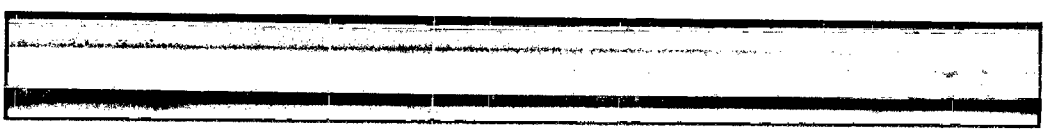
E) L=p+5

39. En cualquier triángulo cada uno de los lados debe ser menor a la suma de los otros dos ¿En cuál de los casos que se presentan, no sería posible construir un triángulo?

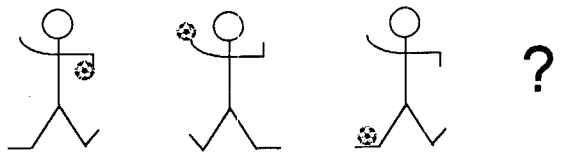
A) 2cm, 4cm, 7cm
B) 4cm, 6cm, 5cm
C) 3cm, 4cm, 5cm
D) 4cm, 2cm, 5cm
E) 2 cm, 4cm, 3cm

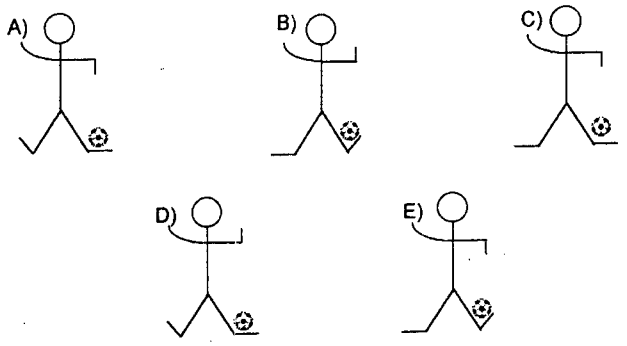
40. En un triángulo rectángulo de 4 unidades de altura por 4 unidades de base, ¿cuántos cuadritos de 1 x1 se forman?

A) 4
B) 6
C) 8
D) 10
E) 16



41. ¿Cuál es la figura que completa la siguiente secuencia?





42. La edad de Alberto hace seis años era la raíz cuadrada de la edad que tendrá dentro de 6 años. ¿Cuál es la expresión que representa la igualdad de las edades?

A) $x-6=\sqrt{x+6}$

B) $x=\sqrt{x+6}$

C) $x+6=\sqrt{x-6}$

D) $x=\sqrt{x-6}$

E) $x+6=\sqrt{x}$

43. Un Jeque árabe tiene 100 mujeres, a la primera le dio un dinar (moneda árabe), a la segunda le otorgó dos dinares, a la tercera tres dinares y así sucesivamente. ¿Qué expresión utilizarías para calcular el total de dinares que repartió a todas sus mujeres?

A) $\frac{n(n+2)}{3}$

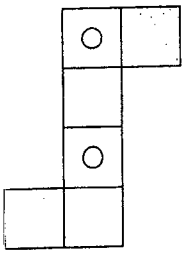
B) $2n-1$

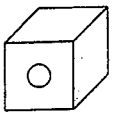
C) $\frac{n(n+1)}{2}$

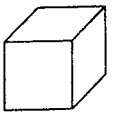
D) $\frac{n(n-1)+2}{2}$

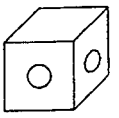
E) $\frac{7n+1}{8}$

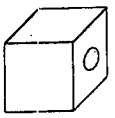
44. ¿Qué cubo se forma a partir de la siguiente figura?

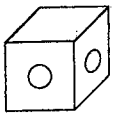


A) 

B) 

C) 

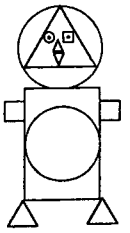
D) 

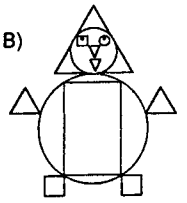
E) 

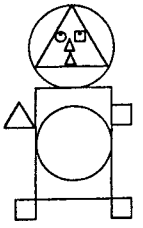
45. Considerando que en una familia Amalia es menor que Luis, pero mayor que Eduardo; Alfonso es mayor que Eduardo, pero menor que Amalia. Asimismo, Tomás es mayor que Luis. ¿Cuál de las siguientes afirmaciones es correcta?

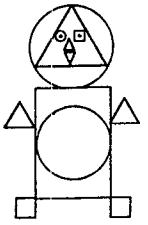
A) Eduardo es mayor que Luis
B) Luis es menor que Alfonso
C) Tomás es menor que Amalia
D) Amalia es mayor que Luis
E) Tomás es mayor que Eduardo

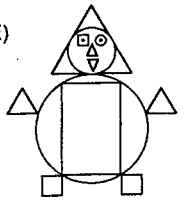
46. De las siguientes figuras, ¿cuál es la que cumple con la descripción que se da a continuación?. Su cabeza es un triángulo que esta contenido en un círculo. Sus ojos son un círculo y un cuadrado que tienen un punto en el centro. Su nariz es un pequeño triángulo, su boca es otro triángulo en posición contraria al de la nariz. Su cuerpo es un rectángulo que contiene a un círculo. Sus manos son dos pequeños triángulos y sus pies dos pequeños cuadrados.

A) 

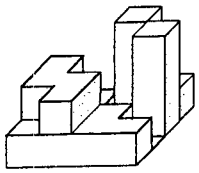
B) 

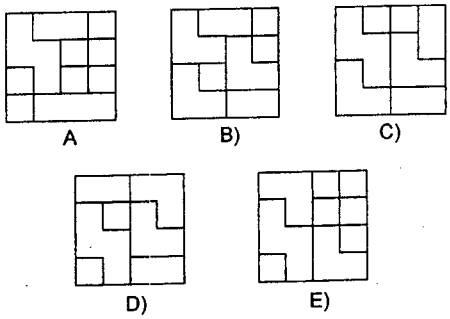
C) 

D) 

E) 

47. ¿Cuál de los planos representa a la estructura vista desde arriba?





48. ¿Cuál es la relación correcta entre los ángulos que muestra el paralelogramo en el cual el vértice θ del triángulo inscrito toca el punto medio del segmento?

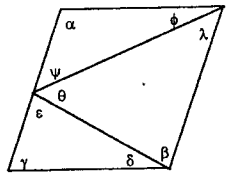
A) $\varepsilon + \gamma = 180° - \delta$

B) $\varepsilon + \delta = 180° - \beta$

C) $\theta + \beta = 180° - \gamma$

D) $\alpha + \phi = 180° - \theta$

E) $\phi + \psi = 180° - \delta$



49. La siguiente tabla muestra el pago de una persona por su trabajo en función del número de computadoras armadas.

Computadoras	Pago
1	300
2	650
3	1000
4	1350

¿Qué expresión se puede utilizar para calcular el pago por un número **n** de computadoras armadas?

A) $300 + 500(n - 1)$

B) $300n + 50(n - 1)$

C) $300(n - 1) + 50$

D) $300n + 50$

E) $300\frac{(n+1)}{2} + 50(n-1)$

50. Supongamos que $a > b$, si $a < 0$ y $b < 0$, entonces $a^2 + b^2$ será:

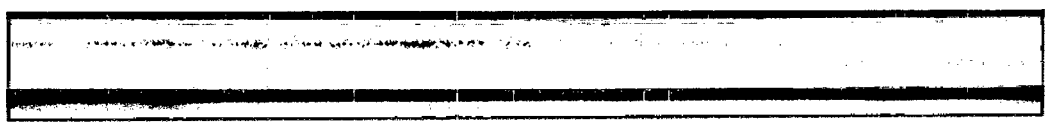
A) igual a cero.

B) mayor a cero.

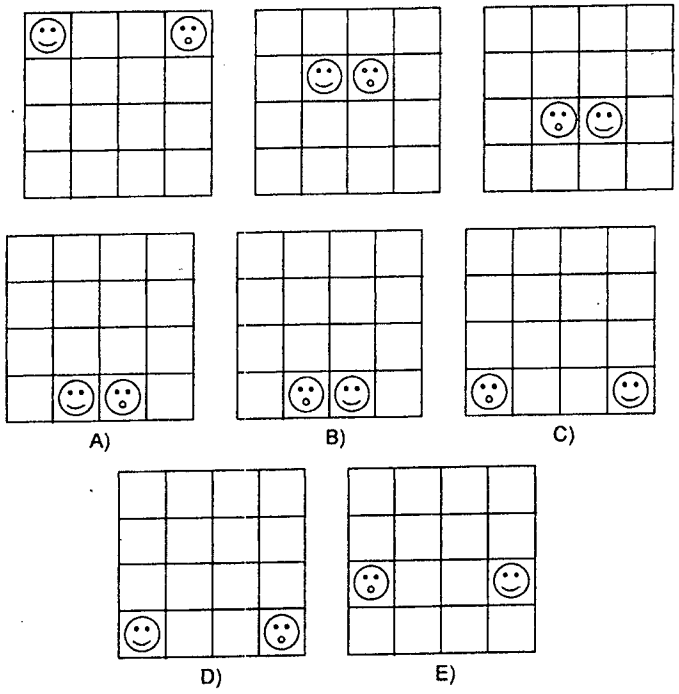
C) menor a cero.

D) menor que a.

E) menor que b.



51. Determine el dibujo que continúa la serie.



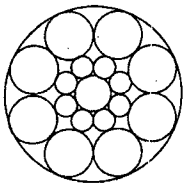
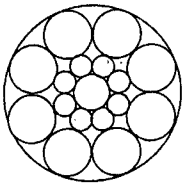
52. ¿Cuál es la representación numérica correcta de la operación matemática, cincuenta y dos millones ciento tres pesos veinte centavos dividido entre doscientos mil dos pesos, diez centavos y sumada con ciento un mil pesos con setenta y cinco centavos?

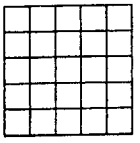
A) 5200010320 / 200002.10 + 101000.75
B) 52000103.20 / 202000.10 + 101000.75
C) 52000103.20 / 200002.10 + 101000.75
D) 52000103.20 / 200200.10 + 1000001.75
E) 52000103.20 / 200002.10 + 1000001.75

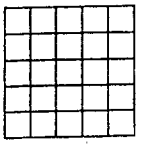
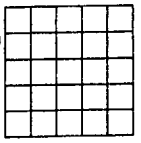
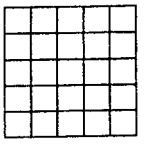
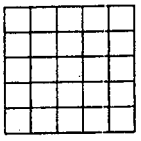
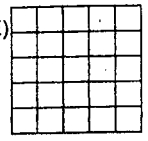
53. Si el primer término de la serie es n, el segundo n + a, el tercero n + a^2, entonces cuál será el vigésimo primer término.

A) $n + a^{21}$
B) $21n + 21a^{21}$
C) $n + a^{20}$
D) $20n + a^{20}$
E) $20n + a^{21}$

54. Observa las siguientes figuras

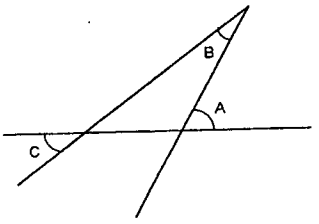
Si  es a 

Entonces  es a:

A) 
B) 
C) 
D) 
E) 

55. A partir de la figura, si el ángulo A mide 65°, ¿cuál de las siguientes afirmaciones es cierta?

A) °B + °C = 65°
B) 65° – °C = °B
C) °B + °C = 115
D) 115° – °C = °B
E) 115° – °B = °C



56. En un aparador de un Centro Comercial se observa al pasar la calle lo siguiente:

R T N

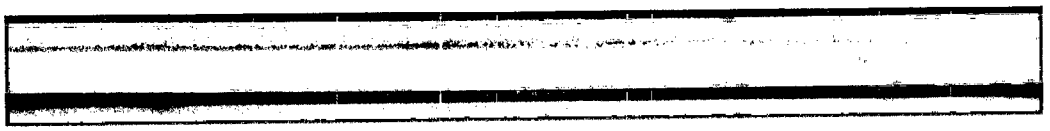
¿Cómo verías la imagen de las mismas letras, desde el interior del aparador?

A) Я ⊥ И
B) N ⊥ Я
C) Я T И
D) И T Я
E) Я ⊥ N

DETENTE

SI TERMINAS ANTES QUE SE TE INDIQUE, REPASA ÚNICAMENTE ESTA SECCIÓN. NO TRABAJES EN OTRAS PARTES DEL EXAMEN

HABILIDAD VERBAL



PARTE III

TIEMPO LÍMITE: 20 MINUTOS

ANTÓNIMOS

INSTRUCCIONES: A continuación encontrarás unos enunciados con una palabra en mayúsculas y cinco opciones de respuesta. Selecciona el antónimo de la palabra que aparece en mayúsculas y responde en tu hoja de respuestas.

57. La familia política quiso APROPIARSE los bienes que dejó el difunto

A) apoderarse
B) ceder
C) transigir
D) aprobar
E) adueñarse

58. La EXASPERACIÓN fue el factor que influyó en su decisión

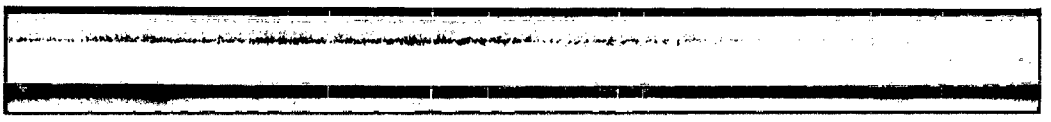
A) calma
B) cólera
C) motivación
D) excitación
E) premura

59. Después de todo, la ZURRA sólo sirvió para tranquilizarlo un poco

A) golpe
B) riña
C) caricia
D) beso
E) apalea

60. El tacto es una de las herramientas más IMPORTANTES con las que contamos para relacionarnos socialmente

A) insignificantes
B) relativas
C) frívolas
D) imperceptibles
E) débiles



ANALOGÍAS

INSTRUCCIONES: A continuación se presenta en mayúsculas un par de palabras relacionadas entre sí, seguidas de cinco opciones con pares de palabras. Selecciona la opción que exprese mejor una relación similar al primer par de palabras y señala en tu hoja de respuestas.

61. BANDERA es a PAÍS como:

A) hombre es a gallardía
B) pasaporte es a viajero
C) trofeo es a competencia
D) héroe es a medalla
E) corona es a rey

62. DESPERTAR es a DORMIR como:

A) comer es a alimentarse
B) pensar es a resolver
C) vivir es a morir
D) dormir es a soñar
E) aprender es a vivir

63. MAMÍFERO es a BALLENA como:

A) lagartija es a camaleón
B) insecto es a mosquito
C) perro es a cuadrúpedo
D) hombre es a mujer
E) vaca es a becerro

64. CONSTRUIR es a DESTRUIR como:

A) dividir es a sumar
B) edificar es a construir
C) cortar es a coser
D) reunir es a separar
E) cocinar es a comer

65. ESCULPIR es a ESTATUA como:

A) pintar es a caballete
B) correr es a sudar
C) cultivar es a cosechar
D) cantar es a canción
E) remar es a oleaje

COMPLEMENTACIÓN DE ENUNCIADOS

INSTRUCCIONES: Los enunciados que se presentan a continuación tienen un espacio en blanco en el que se ha omitido una palabra. Debajo del enunciado hay cinco palabras señaladas con las letras A, B, C, D y E. Selecciona la palabra que al colocarse en el espacio en blanco le proporcione sentido lógico.

66. El buque mercante partió llevando _____ que debía _____ a Europa.

A) carga – transportar
B) mercancía – abordar
C) producto – conducir
D) bienes – destinar
E) utilidades– arribar

67. Factor importante para _____ el éxito, es tener una mente _____ al cambio.

A) combatir – abierta
B) conllevar – cerrada
C) generar – dispuesta
D) producir – opuesta
E) bloquear – accesible

68. Se _____ que el volumen de la música _____ al oído.

A) reconoció – estimula
B) investigó – daña
C) supo – contamina
D) notificó – capacita
E) entendió – altera

69. Las personas _____ actúan antes de reflexionar acerca de las consecuencias de sus actos.

A) obstinadas
B) valerosas
C) indecisas
D) decididas
E) impulsivas

COMPRENSIÓN DE LECTURA

INSTRUCCIONES: Lee detenidamente la siguiente lectura y señala la respuesta correcta a cada pregunta que se presenta, basándote en el contenido de la lectura.

LECTURA I

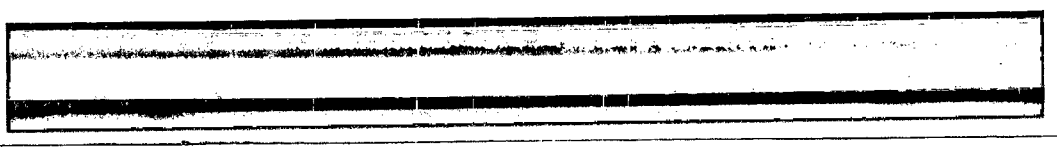
Según la ciencia médica, el tacto es el menos especializado de los sentidos, al menos en los seres humanos. Pese a ello, se trata de una de las herramientas más importantes con las que contamos para relacionarnos. Todos los días nos damos la mano, acariciamos a nuestros hijos o besamos a nuestra pareja. Desde un punto de vista estrictamente físico, percibimos estas sensaciones mediante receptores del tacto, esto es, más de 1,500 terminaciones nerviosas situadas en cada centímetro cuadrado de la epidermis que mandan estímulos al cerebro ante cualquier deformación de la piel.

Sin embargo, el acto de tocar también posee una dimensión psicológica y social que, aunque intuida desde hace siglos, no había sido abordada científicamente hasta hace unas pocas décadas.

Prácticamente oculto entre la miríada de edificios de la Universidad de Miami se encuentra unos de los centros más especializados del mundo en la búsqueda del bienestar del paciente; el Instituto para la Investigación del tacto. En uno de los laboratorios de esta institución, que basa toda su estrategia en la estimulación del contacto físico como medio para combatir algunas dolencias, la doctora María Hernández-Reif investiga los efectos terapéuticos del masaje en mujeres embarazadas aquejadas de depresión, "Lo que pretendemos es averiguar si los masajes pueden reducir su estrés y las complicaciones derivadas de esa situación", afirma.

Pero no sólo se trata de la madres. El equipo de esta misma experta ya descubrió hace años que acariciar a los niños prematuros, algo que se suele evitar en la mayoría de los hospitales, podría ser beneficioso si se hace del modo adecuado.

Lo cierto es que el contacto físico es fundamental a cualquier edad, pero adquiere especial relevancia cuando estamos deprimidos, asustados, cansados o nos sentimos solos. De hecho, psicólogos y pediatras coinciden en que las caricias constituyen una de las mejores formas de transmitir cariño y seguridad.



70. Este texto, al hablar sobre el contacto físico como parte de nuestra vida cotidiana, ¿en qué área del conocimiento lo ubicarías?

A) Psiquiatría
B) Sociología
C) Genética
D) Pedagogía
E) Psicología

71. De acuerdo con la lectura, el sentido del tacto, a pesar de ser una de las herramientas más importantes, ha sido investigada científicamente a partir de:

A) acelerar el desarrollo de los bebés
B) interrelacionarnos mejor con nuestros semejantes
C) desarrollar nuestros instintos empáticos
D) reconocer su dimensión psicológica y social
E) descubrimientos realizados hace algunas décadas

72. La estimulación del contacto físico como medio para combatir algunas dolencias, se ha utilizado como una:

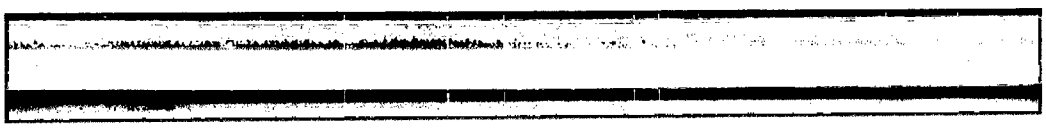
A) forma de comunicación psicológica
B) manera de motivación
C) estrategia terapéutica
D) búsqueda de aceptación
E) herramienta receptora

73. ¿Cuál es el tema que aborda el texto?

A) las enfermedades psicológicas
B) las sensaciones de las caricias
C) la creación de un instituto
D) la importancia del tacto
E) los estímulos del cerebro

74. Son los elementos necesarios para la interpretación de un contacto.

A) piel, estímulo y cerebro
B) contacto, piel y cerebro
C) sensación, estímulo y piel
D) estímulo, piel y sensación
E) sensación, cerebro y contacto



ANTÓNIMOS

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75. En México se han reducido los niveles de MORTANDAD

A) inmortalidad
B) natalidad
C) hecatombe
D) existencia
E) vitalidad

76. Tomo con RESIGNACIÓN la mala noticia que le notificaron

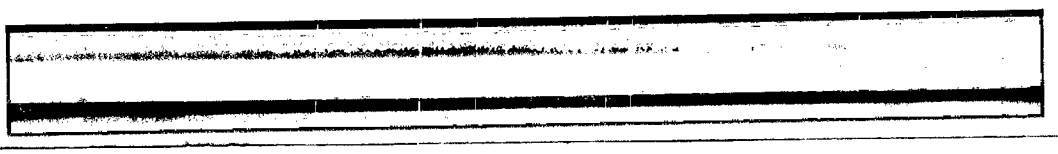
A) renuncia
B) humildad
C) rebeldía
D) inconformismo
E) soberbia

77. Con OSADÍA se ejerce el periodismo. Dijo el maestro de ceremonias en la entrega de premios.

A) arrojo
B) miedo
C) insolencia
D) atrevimiento
E) audacia

78. El aire puro tiende a VIVIFICAR el espíritu

A) animar
B) coaccionar
C) disuadir
D) atrofiar
E) desanimar



ANALOGÍAS

INSTRUCCIONES: A continuación se presenta en mayúsculas un par de palabras relacionadas entre sí, seguidas de cinco opciones con pares de palabras. Selecciona la opción que exprese mejor una relación similar al primer par de palabras y señala en tu hoja de respuestas.

79. DESACELERAR es a ACELERAR como:

A) activar es a desactivar.
B) movimiento es a fuerza.
C) causa es a origen .
D) acción es a reacción.
E) caminar es a correr.

80. ESTADOS UNIDOS es a WASHINGTON como:

A) México es a Cuernavaca.
B) Arabia es a Kuwuait.
C) Brasil es a Brasilia.
D) Colombia es a Quito.
E) Cuba es a Varadero.

81. PINTOR es a CABALLETE como:

A) carpintero es a llave.
B) profesor es a pizarrón.
C) pescador es a pez.
D) arquitecto es a edificio.
E) albañil es a muro.

82. PALABRA es a LETRA como:

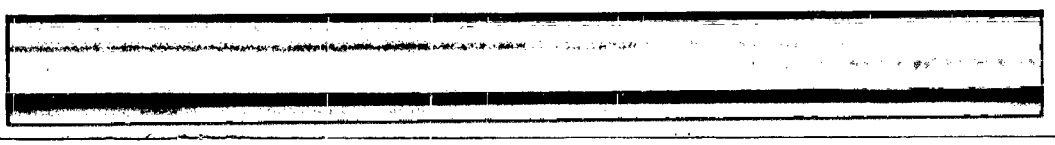
A) hora es a minuto
B) átomo es a electrón
C) tejido es a célula
D) galaxia es a planeta
E) flor es a pétalo

83. GERIATRA es a ANCIANO como:

A) veterinario es a perro
B) biólogo es a fotosíntesis
C) psicólogo es a terapia
D) pediatra es a niño
E) ginecólogo es a bebé

DETENTE

SI TERMINAS ANTES DEL TIEMPO ESTABLECIDO, REPASA ÚNICAMENTE ESTA SECCIÓN. NO TRABAJES EN OTRAS PARTES DE LA PRUEBA.



PARTE IV

TIEMPO LÍMITE: 40 MINUTOS

COMPLEMENTACIÓN DE ENUNCIADOS

INSTRUCCIONES: Los enunciados que se presentan a continuación tienen un espacio en blanco en el que se ha omitido una palabra. Debajo del enunciado hay cinco palabras señaladas con las letras A, B, C, D y E. Selecciona la palabra que al colocarse en el espacio en blanco le proporcione sentido lógico.

84. La comunidad fue tan intensamente lastimada por el tirano, que encontró motivos suficientes para _____, con violencia.

A) valorar
B) disertar
C) reaccionar
D) olvidar
E) discernir

85. Los micrómetros son instrumentos que miden longitudes muy pequeñas con mucha _____, ya que marcan inclusive décimas de milímetro.

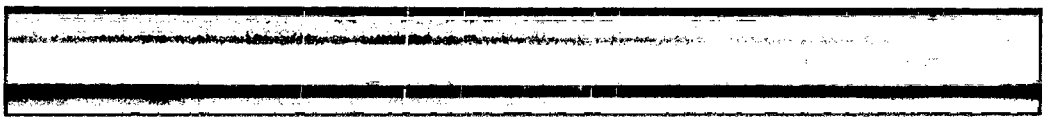
A) rapidez
B) prestancia
C) facilidad
D) claridad
E) exactitud

86. El Mediterráneo es la cuenca marina más _____ del mundo; además del petróleo derramado, recibe _____ domésticos.

A) visitada – extranjeros
B) caudalosa – barcos
C) contaminada – deshechos
D) hermosa – animales
E) extensa – turistas

87. Los sorprendentes avances de la ciencia, han provocado que el hombre actual pierda cada vez más su capacidad de_____ante los nuevos descubrimientos.

A) asombro
B) síntesis
C) indiferencia
D) comunicación
E) análisis



COMPRENSIÓN DE LECTURA

INSTRUCCIONES: Lee detenidamente la siguiente lectura y señala la respuesta correcta a cada pregunta que se presenta, basándote en el contenido de la lectura.

LECTURA II

El carbón y el petróleo desempeñaron el papel de la madera como combustible. El carbón ya fue mencionado por el botánico griego Teofrasto el año 200 a.C., pero los primeros registros de la minería del carbón en Europa no se remontan a antes del siglo XII. Hacia el siglo XVII, Inglaterra, deforestada, y desesperadamente carente de madera para sus navíos, comenzó a derivar hacia el empleo a gran escala del carbón como combustible, inspirada tal vez en el hecho de que los neerlandeses habían comenzado a excavar en busca de carbón. (Pero no fueron los primeros. Marco Polo, en su famoso libro acerca de sus viajes por China a fines del siglo XIII, ya describió cómo quemaban carbón en esas tierras, que eran las más avanzadas tecnológicamente del mundo.)

En 1660, Inglaterra estaba ya produciendo 2 millones de toneladas de carbón al año, o más de 80% de todo el carbón que se producía en el mundo.

Al principio, se empleó sobre todo como combustible doméstico, pero, en 1603, un inglés llamado Hugh Platt descubrió que si se calentaba el carbón de una forma en que el oxígeno no llegase a él, el material que aún contenía podía eliminarse y quemarse. Lo que restaba era carbono casi puro y a este residuo se le llamó coque. Al principio el coque no era de una calidad muy elevada. Se mejoró con el tiempo y llegado el momento pudo emplearse como carbón vegetal (de madera) para fundir las menas de hierro. El coque se quemaba a elevada temperatura, y sus átomos de carbono se combinaban con los átomos de oxígeno del núcleo de hierro, dejando tras de sí el carbono metálico. En 1709, un inglés, Abraham Darby, comenzó a emplear el coque a gran escala para conseguir hierro. Cuando llegó la máquina de vapor, el calor se usó para calentar y hervir el agua y de esa manera la Revolución Industrial recibió un impulso hacia adelante.

ASIMOV, ISAAC (1997) **El carbón y el petróleo**.
En Secretaría de Educación Pública. Cuaderno de trabajo.
Uso del lenguaje. Español. México

88. Hacia el siglo XVII estaba deforestada y sin madera, empezó a usar el carbón:

A) Irlanda
B) China
C) Grecia
D) Europa
E) Inglaterra

89. Uno de los derivados del carbón que tuvo un gran auge en diversas áreas era el:

A) carbón mineral
B) carbón vegetal
C) combustible
D) coque
E) petróleo

90. Inglés que empleó el coque para conseguir hierro.

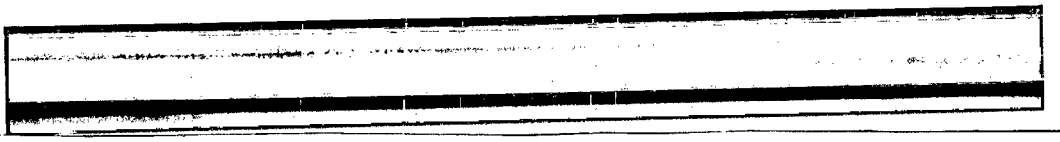
A) Marco Polo
B) Teofrasto
C) Hugh Platt
D) Isaac Asimov
E) Abraham Darby

91. El combustible fósil más aprovechado en las diferentes etapas de la humanidad es:

A) mena de hierro
B) coque
C) petróleo
D) carbón
E) madera

92. El carbón es importante por su:

A) antigüedad
B) empleo
C) descubrimiento
D) invento
E) descomposición



ANTÓNIMOS

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93. Habrá que AMINORAR el uso de aerosoles, para evitar la destrucción del ozono

A) mermar
B) crecer
C) acortar
D) madura
E) medrar

94. Los reconocimientos se enumeraron en el EPÍLOGO

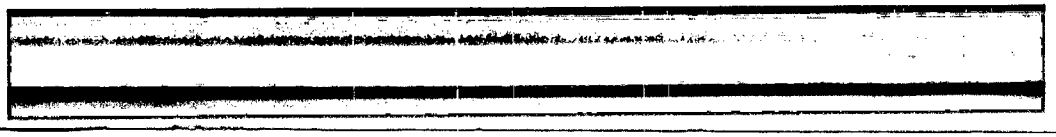
A) prólogo
B) desenlace
C) compendio
D) conclusión
E) recapitulación

95. El toro se siguió de largo ante la INMOVILIDAD del torero

A) tranquilidad
B) inquietud
C) insensibilidad
D) comodidad
E) inequidad

96. Todo comenzó por aquella CALUMNIA en su contra

A) honra
B) infamia
C) mentira
D) mendaz
E) difamación



ANALOGÍAS

INSTRUCCIONES: A continuación se presenta en mayúsculas un par de palabras relacionadas entre sí, seguidas de cinco opciones con pares de palabras. Selecciona la opción que exprese mejor una relación similar al primer par de palabras y señala en tu hoja de respuestas.

97. PROFUNDIDAD es a ALTITUD como:

A) grúa es a elevador
B) auto es a asiento
C) túnel es a tren
D) submarino es a avión
E) puente es a autobús

98. PALABRA es a LETRA como:

A) hora es a minuto
B) átomo es a electrón
C) tejido es a célula
D) galaxia es a planeta
E) flor es a pétalo

99. CANARIO es a AVE como:

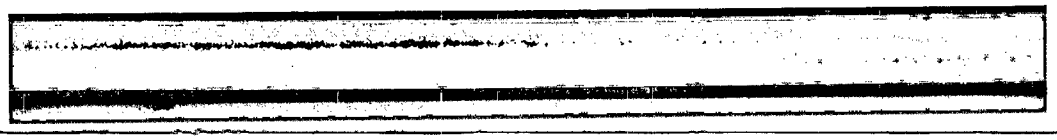
A) víbora es a veneno
B) hombre es a macho
C) mesa es a mueble
D) gato es a maúllo
E) camarón es a mar

100. SOMBRERO es a CABEZA como:

A) tapa es a bote
B) cáscara es a fruto
C) blusa es a saco
D) dedo es a uña
E) tronco es a cabeza

101. TRABAJO es a PRODUCCIÓN como:

A) herramienta es a obrero
B) esfuerzo es a descanso
C) construcción es a edificio
D) jornada es a horario
E) empleo es a desempleo



COMPLEMENTACIÓN DE ENUNCIADOS

INSTRUCCIONES: Los enunciados que se presentan a continuación tienen un espacio en blanco en el que se ha omitido una palabra. Debajo del enunciado hay cinco palabras señaladas con las letras A, B, C, D y E. Selecciona la palabra que al colocarse en el espacio en blanco le proporcione sentido lógico.

102. Aquel personaje era tan _____, que no cambiaba de opinión, a pesar de que las evidencias estuvieran en su contra

A) culpable
B) inocente
C) indiferente
D) obstinado
E) claridoso

103. No lo esperaba aquel soldado, pero llegó a teniente por un verdadero _____

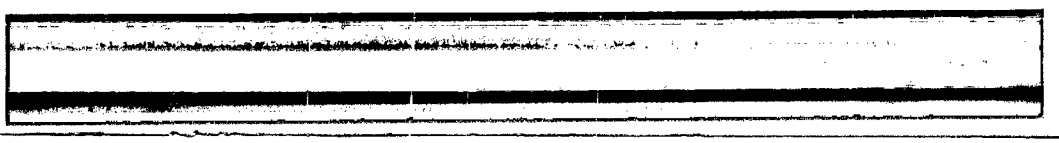
A) asar
B) azar
C) azahar
D) chantaje
E) manipuleo

104 Los hombres bailaron durante toda la noche. Cuando llegó el _____ cayeron _____.

A) rey - a sus pies
B) alba- desaforados
C) día - mitigados
D) momento - desenfrenados
E) amanecer - desvanecidos

105. Si escribes 5555, el último cinco vale exactamente cinco, y no más; el _____ cinco vale diez veces más, es decir cincuenta; y el primer cinco vale diez veces más que el antepenúltimo, o sea _____.

A) antepenúltimo - cincuenta
B) penúltimo - cinco mil
C) penúltimo - cincuenta
D) antepenúltimo - cinco mil
E) penúltimo - quinientos



COMPRENSIÓN DE LECTURA

INSTRUCCIONES: Lee detenidamente la siguiente lectura y señala la respuesta correcta a cada pregunta que se presenta, basándote en el contenido de la lectura.

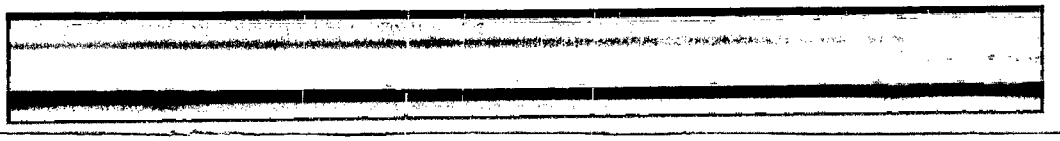
LECTURA III

Muchos animales, como los perros y toros, no son capaces de ver en color. Si pudiéramos mirar a través de sus ojos veríamos que las imágenes que perciben están teñidas de una infinidad de tonalidades grises, que van desde el blanco hasta el negro, como en los televisores antiguos.

Todas las imágenes que vemos se forman en el fondo del ojo, en una superficie curva tan delgada como un papel de fumar: la retina. Esta se comparta como una pantalla de cine, en donde se proyectan los colores, movimientos, profundidad, luces y sombras del mundo que nos rodea y donde una células fotorreceptoras envían toda la información que les llega al cerebro, para que la descifre y la procese.

Nuestra retina está literalmente invadida por cerca de 130 millones de células fotorreceptoras, de las que unas 123 millones son largas y delgadas –los bastones- y las restantes son células cortas y gruesas –los conos- . Entre las primeras están las detectoras de las variaciones de brillo. Si un paquete de luz –un fotón- alcanza a una de estas células, se produce una reacción química que blanquea un pigmento durante una fracción de segundo. Pasado este tiempo, el pigmento vuelve a oscurecerse y, de esta forma, se prepara para recibir otro fotón. Este cambio bioquímico es leído por los nervios ópticos que viajan hasta el cerebro, donde es interpretado. Los bastones son extremadamente sensibles a cantidades de luz muy escasas, pero no están capacitados para apreciar los colores. Por este motivo, vemos en blanco y negro o en tonalidades grises cuando las condiciones de luz son extremas.

Del color se encargan los conos, que en vez de reaccionar sólo ante el brillo, lo hacen de diferentes maneras ante tres colores: verde, azul y rojo. Unos conos son más sensibles a uno u otro color. Por lo tanto, si un animal carece de conos en su sistema visual, como es el caso del toro, en su retina le será imposible percibir el color. Es por ello que los miura jamás envisten al rojo, como se piensa popularmente, sino al torero, al capote o a cualquier otra cosa en movimiento.



106. De acuerdo con la lectura, la retina semeja una pantalla de cine en donde

A) se encuentran las células fotorreceptoras que envían la información al cerebro.
B) se ubican las células detectoras de las variaciones de brillo y colores.
C) se localizan los fotones encargados de mandar a los nervios ópticos la información que es interpretada por último en el cerebro
D) se suman los miles de millones de bastones y conos que envían la información al cerebro.
E) se proyectan las células fotorreceptoras que envían la información al cerebro.

107. Los toros y algunos otros animales no perciben el color, esto se debe a que:

A) presentan una gran cantidad de conos y no de bastones
B) carecen de conos en su sistema visual
C) los paquetes de luz que producen los cambios bioquímicos no llegan a los conos de su sistema visual
D) presentan una cantidad menor de conos que de bastones
E) la retina es una superficie tan delgada como un papel de fumar

108. ¿A qué son sensibles las células fotorreceptoras llamadas bastones?

A) a la reacción química que blanquea a los pigmentos
B) a los cambios bioquímicos
C) a los pigmentos que se obscurecen
D) a los variaciones de brillo
E) a las diferentes tonalidades

109. De acuerdo con el texto, la retina de los seres humanos está invadida de:

A) células fotorreceptoras sensibles al brillo
B) células fotorreceptoras sensibles a los cambios de temperatura y colores
C) células fotorreceptoras sensibles a los cambios bioquímicos
D) células fotorreceptoras sensibles a cantidades de luz muy escasa
E) células fotorreceptoras sensibles al brillo y a diferentes colores

110. ¿Cómo son las imágenes que perciben algunos animales como los perros y toros?

A) policromáticas
B) monocromáticas
C) binoculares
D) estereoscópicas
E) bicromáticas

FINAL DEL EXAMEN

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