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Fluid intelligence and school performance and its relationship with social variables in Latin American samples

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ABSTRACT

As part of the project, "Study of the Latin-American Intelligence" (SLATINT), this study was conducted in six Latin American cities (Rosario-Argentina, Belo Horizonte-Brazil, Santiago-Chile, Bogota-Colombia, Mexico City-Mexico and Lima-Peru) and one European city (Madrid-Spain). The goal was to verify the effect of school performance on fluid intelligence and vice versa after controlling the socioeconomic variables. Students ($N = 3724$) between the ages of 14 and 15 years (51% females) that were enrolled in 66 schools from different socioeconomic levels, participated in this study. The Raven Standard Progressive Matrices test (SPM, fluid intelligence measure), the 2003 PISA test (school performance measure) and a short socioeconomic questionnaire were administered. Diverse multilevel analyses were conducted. The results were: 1) a positive relationship between PISA and SPM, although a stronger correlation was observed as aggregated ($r = .89$), rather than individual scores ($r = .58$) were used; 2) after controlling social variables, the PISA scores could vary up to 7.79 times due to variation in SPM scores; 3) after controlling social variables, the SPM scores could vary up to 1.4 due to variation in PISA scores; 4) the socioeconomic status of schools exerted a greater influence on PISA scores than on SPM scores; and 5) there was a variability among schools regarding school performance (35.2%) and intelligence (6.3%) which was not explained by the covariates and random effects. The impact of these results for education policies is discussed.

1. Introduction

1.1. National differences in school performance

For more than a century, philosophers and economists have highlighted the role of education on individual and national development (Marshall, 1890; Mill, 1848/1909). Currently, the Organization for Economic Cooperation and Development

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(OECD) understands that the prosperity of nations depends largely on how well education systems promote and strengthen the knowledge and skills of individuals (OECD, 2007).

However, a large-scale education that is based only on basic knowledge certainly would be inadequate to meet today's challenges. Reading and writing documents or performing mathematical calculations may have been sufficient competencies up until the previous century when an industrial society was the primary national goal. In the new millennium, modern societies are facing post-industrial challenges where complex technical information, innovation, high-performance workplaces, virtual reality (cutting-edge technology) and increasing uncertainties are the current trends (Humburg & van der Velden, 2013). Thus, high-level competences, independent thinking and creativity are demanded. International school assessments would be valid for measuring how prepared a country is to meet the challenges of this new era.

The Programme for International Student Assessment (PISA) is among the most well-recognized international school assessment systems. Created in 1997 by the OECD, the PISA test does not only assess students' knowledge in reading, writing and science but it also examines how well students use knowledge in novel situations, and how well they apply knowledge to manage their lives in an increasingly complex and technological world. There have been five major evaluations: in 2000 when reading was emphasized (participation of 43 countries, 11 of those assessed in 2001/2002); in 2003 with mathematics emphasized (41 countries); in 2006 with science emphasized (57 countries); in 2009 with reading emphasized (75 countries, 10 of those assessed in 2010); and in 2012 with mathematics emphasized (65 countries).

Over time, the PISA results have indicated higher student performance in developed countries and lower student performance in developing countries, especially students from Latin American countries. The exception includes Asian students who currently occupy the top of the international rankings (OECD, 2013).

The participation of Latin American countries in international assessments has not been frequent and at the national level, the evaluations of students did not exist until recently in many Latin American countries (Laboratorio Latino-Americano de Evaluación de la Calidad Educacional, 2013). The first international experimental evaluation of this region began in the 1990s, when several countries began to implement national systems of evaluation and measurements of educational quality. These first experiences presented disappointing results. For instance, in the International Assessment of Educational Progress — Mathematics test of 1991 organized by the Educational Testing Service, Brazilian students received the lowest scores in all of the participating countries, with the exception of Mozambique. In 1995, 11 Latin American countries had agreed to participate in the TIMSS (Trends in International Mathematics and Science Study) test; however, only Colombia and Mexico in fact participated, and unfortunately, their students received lower scores. In 1999, in the second TIMSS assessment, two Latin American countries, Chile and Colombia, again received the lowest scores (Wolff, 2004).

Approximately 10 years after the first international evaluation experience, the PISA test demonstrated again low school performance of Latin American students in all of the = assessments conducted (2000, 2003, 2006, 2009, and 2012). The PISA reports have analyzed specific factors to understand the reasons underlying the low school performance. Among these factors, two have been highlighted: (a) the educational level of parents, and (b) the socioeconomic status (SES) of the students' parents.

Unfortunately, the several published PISA reports (OECD, 2003; OECD, 2005, 2010, 2014) have revealed conflicting results. The actual influence of SES (referred in PISA as the Index of Economic, Social, and Cultural on School Performance) remains an open question, which may be related to inaccurate SES measurements used in the assessment of PISA (Willms & Tramonte, 2014). In general, according to PISA reports, the effect of SES (based on parents' education and occupation, number and type of domestic possessions, and the educational resources available at home) on individual differences in school performance is greater in some developing countries than in developed countries.

Additionally, another result has captivated the attention of researchers: the relationship between school performance and students' socioeconomic background seems to be stronger between-schools than within-schools. The effects of the school's economic, social and cultural status (referred to now as SES-school) on students' performance by far outweigh the effects of the individual student's socioeconomic background (referred to now as SES-individual). Since 2000, these result patterns have been consistent in the majority of Latin American countries (OECD, 2014).

Moreover, a regional study involving 16 Latin American countries (Duarte, Bos, & Moreno, 2010) demonstrated that only a variance of 1.7% of student achievement in schools was explained by variability in the socioeconomic status of students within the school (individual-SES), whereas a variance of 49.2% was explained by the socioeconomic characteristics of schools (or SES-school). Consequently, among the socioeconomic variables, SES-school seems to be an important factor for explaining the school achievement variation. SES-school is represented by a community's characteristics, such as a safe environment, and the availability of educational resources, such as public libraries or museums (OECD, 2013).

Inversely, the numerous international reports on school performance rarely consider an important psychological variable, i.e., intelligence. The importance of socioeconomic variables with regard to knowledge tends to diminish when intelligence comes into play.

1.2. Intelligence and school performance

One of the few certainties in scientific psychology is related to the strong association between school performance and intelligence (Jensen, 1998; Neisser et al., 1996). On average, children with higher IQ scores do better on standardized school achievement tests, have higher school grades, remain more informed and updated about the world, and complete more years of education (Deary, Strand, Smith, & Fernandes, 2007; Flores-Mendoza, Jardim, Abad, & Rodrigues, 2010). Although several studies have indicated that there are other similarly important factors that predict academic performance, such as motivation, self-control, personality dimensions (Chamorro-Premuzic, Furnham, & Ackerman, 2006), intelligence is usually argued to be the best single predictor of knowledge