



THE ROLE OF CULTURE IN PREDICTING STUDENTS' ACHIEVEMENT: INTERNATIONAL PERSPECTIVES

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ABSTRACT

We amended the rich PISA (Program for International Student Assessment) data to include culture measures of power distance; uncertainty avoidance; individualism-collectivism; masculinity-femininity; and long- and short-term orientation based on country. The added scores of each country on the culture components were obtained from the extensive studies of Hofstede and colleagues (2010). The dependent variables in our study are students' achievements in the fields of reading, math, and science from various countries taken from PISA data.

There are three proposed research questions: Do the various aspects of culture have an effect on students' achievement internationally? Which of the culture measures explains a significant proportion of the variance of reading, math, and/or science achievement scores? Are the values specifically explanatory for one type of achievement over another?

In order to answer our research questions, we have created a series of regression equations that regress achievement scores on a series of control variables as well as country culture scores.

INTRODUCTION

Identifying factors that determine students' achievement has been a common topic of interest for researchers around the world. Aside from academic related activities, such as studying at home, time spent at school, and other study-related activities, there are other factors that influence the level of student achievement. From an international perspective, the culture of the country is also a consideration including how the culture affects familial academic support, and direct classroom activities. Hofstede (1984, p. 21) defined culture as "the interactive aggregate of common characteristic that influence a human group's response to its environment". Culture is owned by ethnic group or groups of people in a certain region. In this paper, the word "culture" denotes the set of values and characteristics of a country that influence the way people behave and respond to their environment. Culture affects all aspects of life, how people view things, the way they act and behave, and this also includes how people view achievement. In line with these statements, studies analyzing students' academic related-emotion indicate that students from Eastern countries are more likely to experience higher levels of achievement as well as anxiety than do students from Western countries (e.g., OECD, 2004). Likewise, in a comparative study between Germany and China, Frenzel and colleagues (2007) found that Chinese students experienced higher levels of mathematics anxiety than did German students. Furthermore, using the Academic Emotions Questionnaire-Mathematics, they found that Chinese students experienced higher levels of mathematics related enjoyment, pride, and



shame, whereas German students experienced higher levels of anger. These types of emotions together encompassing, enjoyment, pride, and at the same time, shame, may encourage students to achieve higher scores. Perhaps it is enjoyment that persuades students to study, or the pride (of achieving good grades) that motivates them to get high scores, and perhaps the shame (of getting bad/low grades) encourages them to study more earnestly in order to earn good grades. These explanations may contribute to why countries like Shanghai-China, Hong Kong-China, as well as Singapore ranked high in the PISA 2009 tests in mathematics and outperformed western countries.

WHAT IS PISA?

The Program for International Student Assessment (PISA) is a worldwide evaluation of 15-year-old school pupils' scholastic performance in reading, mathematics, and science literacy. PISA is coordinated by the Organization for Economic Cooperation and Development (OECD), an intergovernmental organization of industrialized countries. Tests are typically administered to between 4,500 and 10,000 students in chosen countries. Performed first in 2000, PISA has been subsequently administered every three years, 2003, 2006, and 2009. Every period of assessment focuses on one of the three competence fields; reading, math, or science; but includes testing of the other two areas as well. The most recent PISA administration occurred in 2009 and focused on reading literacy. The test design, implementation, and data analysis is delegated to an international consortium of research and an educational institution led by the Australian Council for Educational Research (ACER).

PISA tests for literacy in three competence fields: reading, mathematics, and science. The PISA tests include assessments of reading, mathematics, science, problem-solving, and computer-based testing. The battery also includes questions pertaining to background and demographics. PISA also includes measures of general or cross-curricular competencies such as problem solving. The tests investigate if students are prepared to meet the challenges of the future; whether they are able to be analytical thinkers and effective communicators.

DIMENSIONS OF CULTURE

In 1980, Hofstede proposed five dimensions of culture. The first, “femininity and masculinity” reflects the general tensions to which all societies in the world must cope. Femininity/ masculinity is concerned with social and ego goals often reflected within gender. The second dimension, “individualism/ collectivism” is related to the relationship between individuals. Thirdly, “uncertainty avoidance” is about unpredictability of the future. The fourth dimension is “power distance” and is concerned with human inequality, and finally the fifth dimension is “short/long term orientation” and is related to the problems of choosing between virtue and truth (Hofstede, 1998)

When the concepts of femininity and masculinity were first introduced by Hofstede in 1980, some countries that were either excluded or were identified as feminine recorded criticisms. Hofstede (1998) explained that masculinity and femininity were culture dimensions that belong to anthropology, not psychology. Masculinity denotes a society where men are required to be assertive, and focus on material success, while women are assumed to be more modest and concerned with quality of life. Femininity, in contrast, represents a society in which both men and women are cast as more tender, modest, and concerned with quality of life (Hofstede (1998, p. 6-7).

Individualism and collectivism refer to the relationship between the individual and the society. In some cultures, individualism is considered a source of welfare, in others it is



alienating (Hofstede, 2001). Individualism is a cultural pattern that emphasizes individual autonomy and independence; while collectivism culture is a social pattern of closely linked individuals who define themselves as interdependent of a collective (Vandello & Cohen, 1999, p. 279). The other dimension of culture, power distance, is defined as the degree to which inequalities among people are considered as appropriate and acceptable. In cultures where inequalities are considered appropriate, they are categorized as cultures with high-power distance, in contrast to cultures that value equality (low-power distance) (Hofstede, 2001; Richardson & Smith, 2007).

Long term orientation values future rewards, in particular perseverance, thrift, and adapting to changing. It refers to 'the degree to which one plans for and considers the future, as well as values traditions of the past' (Nevis, Bearden, & Money, 2007). On the other hand, short-term orientation represents the fostering of virtues related to the past and present, in particular respect for tradition, saving "face", and fulfilling social obligations (Venaik & Brewer, 2010).

Uncertainty avoidance is defined as the extent to which the members of a culture feel threatened by ambiguous or unknown situations. People from cultures with high uncertainty avoidance levels have lower tolerance for uncertainty, higher needs for structure, and stronger faith in institutions than people from cultures with low uncertainty avoidance levels (Hofstede, 1991).

PISA SCORES ACROSS COUNTRIES: DETERMINING FACTORS

In the case of Finland, the top scoring country, it is possible that the culture of reading at an early age and high-esteemed libraries are in part responsible for the high PISA reading evaluation (Brueggeman, 2008). Perry and McConney (2010) found that school socioeconomic status level, that is the collective socioeconomic status of the student body, has a strong effect on students' achievement. Their study, focusing on Australia's scores, examined the curriculum differences between public and private schools. Public and private schools often differ in terms of socioeconomic status and consequently apply different types of curriculum. Private schools that consist of large number of high socioeconomic status students are more likely to focus their curriculum on academic preparation for universities' examination; whereas public schools with more diverse students' backgrounds are more likely to apply a vocational curriculum. Thus, the academic focused curriculum offered by private schools may correlate with higher scores in PISA assessments (Edwards, 2006; Perry & McConney, 2010).

In another study, Dolin and Krogh (2010) observed that the science curriculum in Denmark has different objectives than those specified in PISA, which in turn influenced the low scores of Danish students. Therefore, they argued that PISA may not reflect the actual science competence of Danish students. In terms of socioeconomic inequity, even EU member states varied significantly. Another different factor pertaining to PISA score is the school interest and school climate. As stated by Basl (2011), natural sciences is not popular among students in the Czech Republic, this may cause the low interest of the students in science-related occupations, that ultimately would have an effect on the low scores of PISA science literacy among their 15 year old students.

METHODOLOGY

The unrestricted PISA data does not contain individual test scores. Rather, they supply what are called plausible values that cannot be directly tied to individual achievement. We therefore, aggregated country characteristics and used the average country scores in reading,



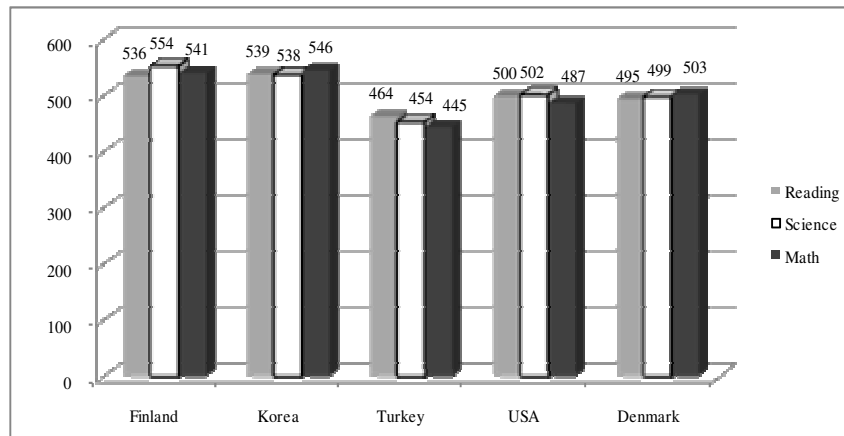
science, and math that are available through the PISA website (<http://www.oecd.org/dataoecd/54/12/46643496.pdf>). We input the five cultural dimensions as earlier discussed, namely, Individualism-collectivism, Long/Short-Term Orientation, Masculinity/Femininity, Uncertainty Avoidance, and Power Distance.

In order to understand the simple relationships between the individual PISA scores and the measures of culture we examined the Pearson Product-Moment coefficient correlations. Finally, we separately regressed the average reading, math, and science scores against the five culture scores.

RESULTS

It is important to note a pattern of achievement in each country scores in reading, science, and math. In other words, countries typically score similarly for all three tests; as a whole countries scoring high in one area score high in all three. For example, Finland's score in reading, math, and science is 536, 541, and 554 respectively meaning that there are only 18 points difference across the three tests. Similarly for Turkey, the scores in reading, science, and math are 464, 454, and 445 respectively; only 19 points of difference. Figure 1 provides a graphic display of this trend.

Figure 1. Countries scores in PISA 2009



The relationship between the three scores is very evident in the simple bivariate correlations. Note that the correlations between reading and math is .966; between math and science is .981, and between science and reading is .979. These correlations are extremely high indicating very little difference between the three scores. In fact, these correlations are so high as to suggest that all three of the scores are measuring the same constructs; specifically achievement without differentiation between subjects.



Table 1. Correlations between the cultural dimensions and PISA scores (reading, science, and math)

Correlations

	Individualism-collectivism	Long /Short Orientation	Masculinity Femininity	Uncertainty Avoidance	Power distance	Reading	Science	Math
Individualism-collectivism	1	-.677**	.031	-.314	-.688**	.480**	.456*	.446**
Long /Short Orientation	-.677**	1	.054	.192	.569**	.053	.119	.094
Masculinity/Femininity	.031	.054	1	.222	.092	-.033	-.027	.009
Uncertainty Avoidance	-.314	.192	.222	1	.339	-.388*	-.383	-.418*
Power distance	-.688**	.569**	.092	.339	1	-.386*	-.364	-.361*
Reading	.480**	.053	-.033	-.388*	-.386*	1	.979**	.966**
Science	.456*	.119	-.027	-.383	-.364	.979**	1	.981**
Math	.446**	.094	.009	-.418*	-.361*	.966**	.981**	1

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at

the 0.05 level (2-tailed).

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Descriptive Statistics

	Mean	Std. Deviation	N
Individualism-collectivism	53.0303	25.01310	33
Long/Short-Term Orientation	43.8333	18.41471	24
Masculinity/Femininity	49.1212	20.76920	33
Uncertainty Avoidance	63.6875	26.47024	32
Power Distance	49.0313	19.81932	32
Reading	482.3939	41.44193	33
Science	491.2069	48.92588	29
Math	481.0606	53.65977	33

The results of the regression analyses are presented in tables 3 to 5. The independent variables in each of the three equations are individualism-collectivism, long/short-term orientation, masculine-femininity, uncertainty avoidance, and power distance while the dependent variables are the PISA reading, science, and math scores. As might be expected judging from the high correlations of the dependent variables, the resultant regression equations are very similar for math, science, and reading. All of the equations were statistically significant (Reading F=3.965; Math F=3.815; Science F=3.085) and explained 40.6% of the variance in reading, 39.7% in Math, and 34.7% in Science. Two of the cultural dimensions were statistically significant; namely individualism-collectivism and long/short-term orientation.

Table 3. Regression analysis between individualism-collectivism, long/short-term orientation, masculine-femininity, uncertainty avoidance, power distance, and reading score

Coefficients^a

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	383.604	46.491		8.251	.000
Individualism-collectivism	1.196	.357	.705	3.350	.002
Long/Short-Term Orientation	1.291	.454	.492	2.843	.009
Masculinity/Femininity	-.118	.292	-.059	-.403	.690
Uncertainty Avoidance	.041	.300	.023	.136	.893
Power Distance	-.425	.420	-.198	-1.011	.321

a. Dependent Variable: Reading_mean



Table 4. Regression analysis between individualism-collectivism, long/short-term orientation, masculine-femininity, uncertainty avoidance, power distance, and science score

Coefficients ^a					
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	386.148	54.011		7.149	.000
Individualism-collectivism	1.214	.415	.649	2.925	.007
Long/Short-Term Orientation	1.428	.528	.494	2.707	.012
Masculinity/Femininity	-.107	.340	-.049	-.316	.755
Uncertainty Avoidance	.070	.348	.037	.202	.841
Power Distance	-.497	.488	-.211	-1.018	.318

a. Dependent Variable: Science_mean

Table5. Regression analysis between individualism-collectivism, long/short-term orientation, masculine-femininity, uncertainty avoidance, power distance, and math score

Coefficients ^a					
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	349.387	58.187		6.005	.000
Individualism-collectivism	1.512	.447	.702	3.382	.002
Long/Short-Term Orientation	1.712	.568	.514	3.013	.006
Masculinity/Femininity	-.032	.366	-.013	-.088	.931
Uncertainty Avoidance	.032	.375	.014	.084	.934
Power Distance	-.575	.526	-.211	-1.093	.284

a. Dependent Variable: math_mean

To graphically display the strength of the relationship between the two significant predictors and each of the PISA scores, we present figures 2 through 4 that provide scatterplots with the regression line overlay. Note that points have been labeled by the name of the country.

Figure 2. Relationship between individualism-collectivism and reading score

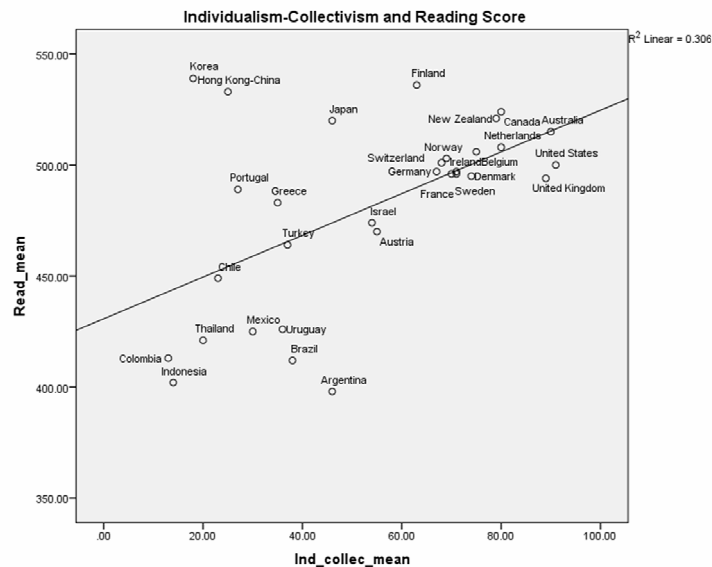




Figure 3. Relationship between individualism-collectivism and science score

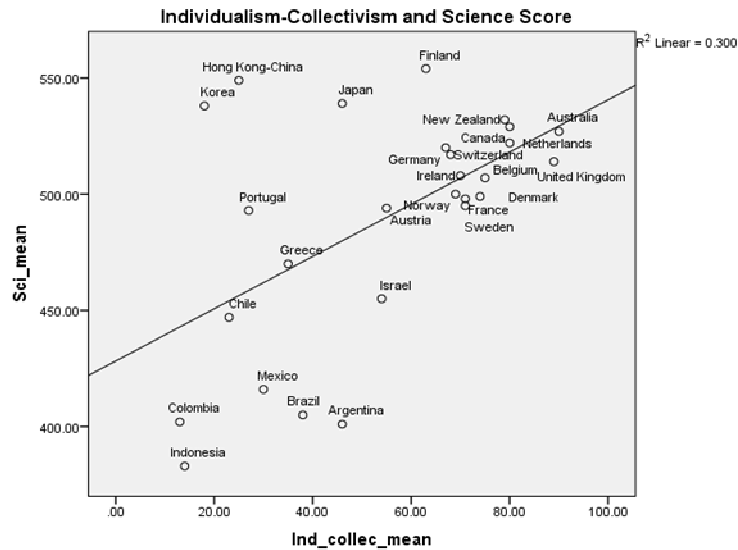
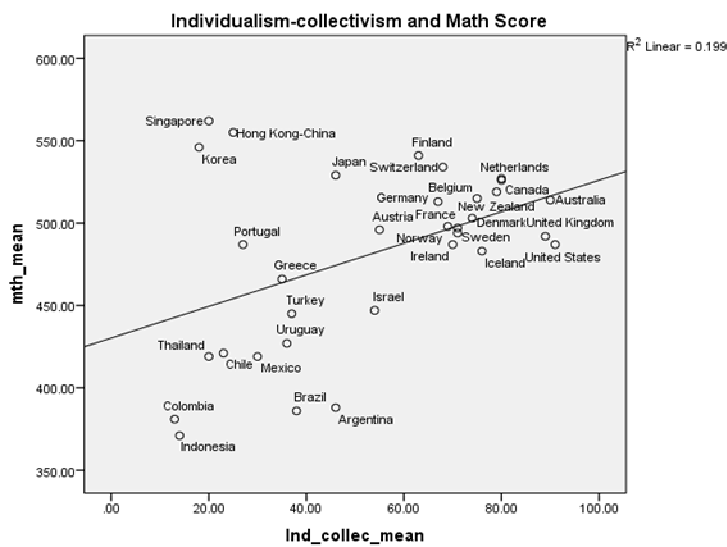


Figure 4. Relationship between individualism-collectivism and math score



DISCUSSIONS AND CONCLUSION

The strength of our analyses lies with its simplicity. First, the extremely high correlations between the reading, science, and math scores interject serious questions. Although one might expect that countries scoring high in one area would likely score high in others, correlations over .90 indicate almost no variation in score. One is left to wonder if there are



reasons why the students of some countries test well overall and others do not. Could part of the answer be that the culture of the country is such that it better prepares its students to test well?

The simple, yet statistically significant regression equations are troubling and certainly pose questions for international comparison studies. We posit that the ability of the culture scores to predict a significant proportion of the variance of test scores indicates that culture plays a larger role in test results than previously considered.

Countries that are highly individual (versus collective) are more likely to score high on all three tests. One must consider that testing is an individual and competitive activity. Cultures that embrace individualism and competitive achievement therefore may be more likely to score irrespective of instructional quality. Students in countries that are more collective in nature may not take individual tests with the same fervor or understand the high-stakes involved. A lack of competitiveness may further disincline students from testing well. Moreover, students from individualist countries may better equate education with improvement of self-worth; whereas for students in collectivist countries, education may be seen as a vehicle for social acceptance over individual self-respect (Dudek, 2008). The United States has the highest individualism score (91), while the lowest scoring country is Guatemala (6).

The second statistically significant cultural element is long/short-term orientation. Long-term orientation is related to persistence, ordering relationships by status and observing this order, thrift, and having a sense of shame. On the other hand, short-term orientation is related to personal steadiness and stability. Countries with long-term orientations are more likely to have higher PISA scores. An example of a high scoring country with respect to a long-term orientation is Korea (75). Hofstede(2001) has argued that countries influenced by Confucius teaching tend to have a long-term orientation compare to those that do not.

Perhaps it is not surprising that countries with a long orientation have higher scores. Simply stated, testing is not enjoyable. In order to understand the consequences of taking a test a student must accept that although not comfortable, the results of the test may be assistive in the longer time frame. The culture must embrace the need for education today for a better tomorrow. In a long-term orientation country, students are embarrassed or feel shame if their test scores are not acceptable. Our analyses provide evidence of the power of culture and its effect on achievement. Our analyses also raise questions about the validity of international comparisons when testing is the medium of measurement.

The third research question: 'Are the cultural values specifically explanatory for one type of achievement over another?' Based on the standardized coefficients β , we can conclude that the impact of individualism-collectivism and long/short-term orientation dimensions on countries' achievement in reading, science and math do not highly differ. The respective regression analysis between the variables of individualism-collectivism and reading indicates β values of .705, for science .649, and for math .702.

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