CHAPTER 5

The Curious Case of International Student Assessment: Rankings and Realities in the Innovation Economy

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Our purpose for this study was to explain the strength and direction of the relationships between rankings on international tests of academic achievement and indicators of national creativity, innovation, and entrepreneurship. Data were collected from rankings on international indices that measure the vocational competencies of creativity, innovation, and entrepreneurship and rankings from the Trends in International Mathematics and Science Study (TIMSS) 1995 and Programme for International Student Assessment (PISA) 2000 and 2003 mathematics rankings for G20 member countries. Results from this study suggest that rankings on international tests of mathematics administered in 1995, 2000, and 2003 do not correlate with rankings of G20 countries on recent indices of creativity, innovation, and entrepreneurship. Claims are questioned by U.S. bureaucrats and pundits to the effect that standardization and centralization of curriculum and assessment are necessary for improving rankings on international tests, and thus improve vocational competencies vital in the innovation economy.

Some legislators and bureaucrats at the state and national levels expect public school administrators in the United States (U.S.) to implement policies and programs that will improve the rankings of U.S. students on international tests of mathematics. It is claimed that the rankings from such tests are barometers of future global economic performance. Some media in the U.S., bureaucrats, legislators, and education commenters often cite the rankings of U.S. students on the Programme for International Student Assessment and the Trends in Mathematics and Science Study assessments as evidence of the need for their various school reform policies.

The policy-making interest in international test rankings is not confined to U.S. policymakers. The 2011 TIMSS and 2012 PISA results garnered scrutiny of public

education school administrators in countries such as Australia, China, England, Finland, Denmark, France, Germany, Korea, Norway, and Singapore (Organisation for Economic Co-operation and Development [OECD] 2013a). Andreas Schleicher (2014), coordinator of the PISA test, commented that the results from PISA are important indicators of education quality and future economic growth that should be used to inform education policy. The interest in rankings from international tests is especially intense, given the backdrop of the global economic crisis of 2008, because of the perceived urgency of policymakers across the globe to grow their economies and provide skilled labor to their industries.

Since 2008, legislators and bureaucrats developed and implemented a flurry of education reform policies in the U.S. with the stated purposes of increasing student achievement and preparing children to be globally competitive. Teacher evaluation mandates, centralized curriculum via the Common Core State Standards, national standardized testing through the Smarter Balanced Assessment Consortium (SBAC) and the Partnership for Assessment of Readiness for College and Careers (PARCC), and increases in the number of charter schools are examples of neoliberal initiatives enacted under the guise of improving student achievement and global competitiveness (see Mullen, English, Brindley, Ehrich, & Samier, 2013), measured in part by student rankings on international tests of mathematics.

School administrators are charged through state and federal legislation and statutes to implement policies aimed, in part, at improving performance on international tests of mathematics. But what evidence exists that suggests achievement on international tests leads to student attainment of vocational competencies that will be valued when they begin their careers in the global economy?

Problem, Purpose, and Research Probes

Since the post-No Child Left Behind (NCLB) era, little quantitative research is available on the relationship between rankings on international tests of mathematics rankings and indicators of some of the vocational competencies of global competitiveness such as creativity, innovation, and entrepreneurship, in the G20 group of countries: Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Republic of Korea, Mexico, Russia, Saudi Arabia, South Africa, Turkey, United Kingdom, and United States.

Race to the Top, the Common Core State Standards, and other accountability-driven policies are founded on the claim that U.S. students are not prepared to compete in the global economy as evidenced by results on international tests and, further, that such policies are a solution for fostering global competitiveness. Bureaucrats draw sweeping cause-and-effect conclusions between rankings on international tests and general readiness to compete in the innovation economy.

The purpose of this study was to explain the strength and direction of the relationship among the rankings on indices that measure the vocational competencies of creativity, innovation, and entrepreneurship of adults aged 25-35 and the TIMSS 1995, PISA 2000, and PISA 2003 mathematics rankings for G20 member countries. The rankings from the 1995 TIMSS and the 2000 and 2003 PISA math tests represent output from former students (now 25-to-35 years old) who work in the evolving innovation

economy. They represent the most recent age-group of college graduates as defined by the OECD (2012) and the age group surveyed by the indices of creativity, innovation, and entrepreneurship used in this study.

We guided our study with the overarching question: What is the strength and direction of the relationship between the 2000 and 2003 PISA mathematics ranks of participating G20 nations and their ranks on 2013 global indicators associated with the innovation economy? We also used these subsidiary questions:

1. What are the strength and direction of the relationships between ranks for G20 countries in mathematics on the 1995 TIMSS, and 2000 and 2003 PISA tests and their rankings on the Global Innovation Index?
2. What are the strength and direction of the relationships between ranks for G20 countries in mathematics on the 1995 TIMSS, and 2000 and 2003 PISA tests and their rankings on the Global Entrepreneurship Index?
3. What are the strength and direction of the relationships between ranks for G20 countries in mathematics on the 1995 TIMSS, and 2000 and 2003 PISA tests and their rankings on the Global Creativity Index?

Conceptual Framework

The conceptual framework derives from our view of the school administrator as a decision maker (Hoy & Miskel, 2013). School administrators make decisions daily about allocations of time, money, and staffing based on information and influences emanating from the macro- and micro-systems in which they administer (Hoy & Hoy, 2013). An example of an influence from the micro-system includes a policy adopted by a local board of education, whereas an example of an influence from the macro-system is a program like the Common Core State Standards initiative thrust upon school districts in 45 states, developed, in part, to address the negative bias of policymakers that U.S. students lag behind their international peers on international tests of mathematics.

Our conceptual framework aligns with Vroom and Jago's (1988) model of decision effectiveness in which access to quality information drives administrator action. As decision makers, school administrators must decide whether to pursue specific policies and practices, or how zealously to pursue them, based on the information available to them at the time they make a decision. Therefore, research that helps explain the level of effectiveness of a proposed or mandated program or substantiates a policy claim can prove useful to administrative decision-making and the well-being of schools

Literature in a Snapshot

The release of the 2012 PISA (OECD, 2013a) and the 2011 results from the TIMSS (Mullis, et al, 2012) ignited crises pandering on the part of pundits, education bureaucrats, and policymakers about supposed failures of the American public school system. Public school administrators sustained yet another round of dire warnings by bureaucrats (e.g. Duncan, 2013) and some corporate elites (e.g., Barber, 2013) about how the PISA and TIMSS results for America demonstrated a lack of global economic competitiveness. Simultaneously, calls to embrace standardization of the public school

system via programs like the Common Core State Standards initiative and national testing came from the U.S. Department of Education and state legislatures. However, some researchers (e.g., Mansell, 2013; Puchhammer, 2007; Sjoberg, 2012; Zhao, 2014; 2012a) question the relevancy of the skills and knowledge tested by PISA and TIMSS and the assumption driving these tests that the skills tested are somehow indicative of those necessary for competing in a global economy.

Secretary of Education Arne Duncan casts doubt on the health of education in the United States, referring to the 2012 PISA math and science results as an indicator of "educational stagnation" for the nation. President Barack Obama used "Sputnik moment" in his 2011 State of the Union address to signal a need for reform that will standardize public education by increasing the nation's global competitiveness via higher student scores on international tests like PISA and TIMSS. But how warranted are the calls of impending economic doom owing to the ranking (regardless of whether it is low) on tests like TIMSS and PISA?

Influences on PISA and TIMSS

School administrators need accurate information about the quality of results from international tests and about the other important outcomes those results relate to or predict. The authors of the PISA and TIMSS (OECD, 2013a; Mullis et al., 2012) produced technical manuals that detail the overall strengths and weaknesses of the tests and the results. Because bureaucrats from many of the over 65 countries and cities that participate in PISA use the results to inform or make policy proposals, it would be helpful for school administrators across the globe to know what the authors of the PISA (OECD, 2013a) stated about how the results from PISA relate to the overall quality of a country's education system.

> If a country's scale scores in reading, scientific or mathematical literacy are significantly higher than those in another country, it cannot automatically be inferred that the schools or particular parts of the education system in the first country are more effective than those in the second. (p. 265)

School administrators need to know that the OECD authors make it clear that the PISA results should not be over-inferred in terms of education quality and that the results need to be inferred in the context of experiences outside of school. Armed with that information, school administrators could then find out, through further reading of the technical manuals, that poverty explains up to 46% of the PISA mathematics score in OECD countries like the U.S. (OECD, 2013b). Keep in mind that the United States has one of the highest childhood poverty rates of the OECD countries (OECD, 2009) with more than 22% of the public school children living in poverty.

Furthermore, approximately 28% of the variance in PISA mathematics results is explained by student math self-efficacy (OECD, 2013b; Tienken, 2014). Math self-efficacy is lower for students from poverty. The influence of self-efficacy on PISA mathematics is strong in the United States and the difference between students with high self-efficacy and students with lower levels self-efficacy is approximately 50 scale score points (OECD, 2013b).

The effects of lowering poverty on PISA and TIMSS results in the U.S. can be modeled using the results from students from Massachusetts (MA) who participated in the TIMSS 2011 and PISA 2012 mathematics tests. Massachusetts provides a view of a less poor America as only 15% of the children live in poverty compared to the U.S. average of more than 22% (Annie E. Casey Foundation, 2010). Tienken (2013) modeled how U.S. ranks on TIMSS 2011 and PISA 2012 mathematics tests changed when looking at a less poor population of American students.

Grade 8 students in MA achieved a scale score of 561 on the TIMSS mathematics test compared to the U.S. average of 509: a difference of 52 scale score points. The difference changes the U.S. ranking to 5th place and on par with Japan (Tienken, 2013).

Tienken (2014) found similar results for the PISA 2012 mathematics test. Students in MA scored 520 on the mathematics portion of the 2012 PISA, propelling the U.S. from 32nd to 12th place, one point behind Estonia. If information about poverty's influence on international tests results was communicated more transparently, then school administrators might be able to better question the policies aimed at improving achievement on PISA that do not help to lower the poverty rate (Tienken, 2014). School administrators might question more deeply the policies that centralize and standardize the public school curriculum and assessment of almost 50 million children in the U.S., in the name of catching up to international peers, if they knew that the main cause of underachievement is not addressed in such policies.

Researchers across the globe continue to raise important questions about PISA and TIMSS results that are important for school administrators to understand. Sjoberg's (2012) critique is that many of the PISA questions lack context and do not require creative or innovative thinking; further, students take different parts of the test, a reality that dispels the myth that everyone is taking the exact same test. Martio (2009) demonstrated that much of the mathematics on the PISA test is derived from early 20th-Century thinking, concluding that the test falls short of reflecting the type or level of math necessary to compete in a global economy.

Some argued that the majority of most challenging PISA mathematics questions require students to solve only multi-step arithmetic word problems, not algebra or geometry (e.g., Dancis, 2014). Stewart (2013) has also described the PISA test and results as flawed, adding that the statistics used to arrive at the results are "utterly wrong" (p. 2). How well do TIMSS and PISA mathematics rankings relate to vocational competencies like creativity, innovation, and entrepreneurship needed for citizens in the G20 countries to be productive in a global economy?

Competitiveness in the Global Economy

To define competitiveness in the global economy, we contextualized our discussion and results in relation to the attributes citizens need to understand and innovate in the world today and tomorrow. It was not our intent to define completely the term "global competitiveness." That is beyond the scope of this writing. Regarding the scope of our work, we integrated literature from economics, education, and business and searched for vocational competencies associated with the various definitions of global competitiveness presented in these three fields.

The global economy has been referred to as the knowledge economy (Duncan, 2013), innovation economy (Massachusetts Institute of Technology [MIT], 2013), and conceptual economy (U.S. Council on Competitiveness [USCOC], 2007). Regardless of what commentators on global competitiveness call it, the terms knowledge, innovation, and conceptual signify that competencies such as imitation and literal comprehension are not enough to produce citizens intellectually equipped to grow the 19 largest economies on the planet. The focus on 19th-century skills has shifted to competencies associated with creativity, innovation, and entrepreneurship (Wagner, 2012; World Economic Forum, 2013).

Researchers at OECD (2013a) claim that the results from the PISA mathematics assessment provide insight into how well the students of various countries are prepared to compete in the global innovation economy. The OECD authors equate the PISA achievement levels to relative preparedness for the global economy and make sweeping claims about a country's competitiveness based on the percentage of students in each country who achieve at the highest of the six levels (p. 64).

The OECD authors (OECD, 2013a) insinuate that PISA results can discriminate among countries whose students are prepared to become educated as professionals in the innovation economy and those capable of only routine work.

> The result of technological progress has been a reduction in the demand for people who are only capable of doing routine work, and an increase in the demand for people who are capable of doing knowledge-based work or manual work that cannot be automated. This leads to a greater polarisation of labour market opportunities, both within and across countries, with a greater proportion of people who will need to be educated as professionals. (p. 26)

The subtle claim is that only children who score high on the PISA will be able to compete for high quality jobs, not only abroad, but also within their own country. Policymakers in the U.S. elevate the insinuation to the claim that ranks on international tests forecast global competitiveness.

Duncan (2013) warned the U.S. public during a speech about PISA 2012 results, "In a knowledge-based, global economy, where education is more important than ever before, both to individual success and collective prosperity, our students are basically losing ground. We're running in place, as other high-performing countries start to lap us" (p. 1). The Secretary made similar assertions about the changing nature of the economy during a speech about the TIMSS results (Duncan, 2012), saying, "A number of nations are out-educating us today in the STEM disciplines—and if we as a nation don't turn that around, those nations will soon be out-competing us in a knowledge-based, global economy" (p. 1).

Duncan implies that because students in other countries outrank U.S. students on the PISA that those same students will work to eclipse the economic dominance of the United States and take high quality jobs from U.S. workers. One might assume, given bureaucratic rhetoric that the results from PISA and TIMSS relate strongly to vocational competencies valued in the innovation economy.

Some commentators from business (e.g., George, 2012; IBM, 2012) identified risk-taking, creativity, innovation, and entrepreneurship on the part of business leaders

and employees as key ingredients for the U.S. to increase its global competitiveness. The World Competitiveness Center (2013) echoed the need for innovative and entrepreneurial skills for the United States to maintain its top ranking on the World Competitiveness Index.

A seemingly contradictory position between bureaucrats and technocrats in the U.S. government and OECD claiming that education is the driving force behind the economy and the business-world position that education must take its cues from the economy and prepare creative, innovative, and entrepreneurial adults exists. The rhetoric from one side suggests that education output drives the economy whereas the other side sees education policy and eventual outcomes factors driven by economic needs (Mullen et al., 2013).

The Chicken or the Egg?

The current curriculum and assessment policy reform proposals of the Common Core era and some reports financed by Conservative think tanks (e.g., Hanushek & Woessmann, 2008) advocate that increases in rankings of U.S. students on international tests of academic achievement will spark continued economic growth. Some evidence from the economic literature refutes that idea.

Harbison and Myers (1956) described the relationship between education and the economy years ago: "Education is both the seed and flower of economic development" (p. 31). They suggested that the countries with large economies and high percentages of their population educated through high school and college, like the United States, require large increases in the tertiary education attainment of a majority of the citizens to have a statistically significant influence on the economy. Developing economies like Ghana, Chad, or Haiti could see improvement with an increase in the numbers of high school graduates (Bils & Klenow, 1998).

Secondly, the investment or disinvestment of resources in the education systems of the G20 countries is driven by economic conditions in each country and influences student achievement. The U.S. serves as a concrete example in terms of disinvestment in education due to an economic downtown. Nationwide, 34 states provided less funding for education in their 2013-2014 budgets than during the 2008-2009 school year because of the collapse of the financial sector in 2008 (Leachman & Mai, 2013). The cuts were upward of 10%-20% in some states and resulted in implementation of practices that negatively influence student achievement, such as raising class sizes to more than 30 students (Dillion, 2011; Semuels, 2014).

Current Reality

Fast-forward 57 years from Harbison and Myers (1956) to the release of the MIT (MIT, 2013) report on innovation and production. The results from that report draw attention to the fact that the largest economies are increasingly driven by the need for innovative solutions created to satisfy myriad problems faced by manufacturers in scaling up ideas.

U.S.-based manufacturing is especially challenged due to the downsizing and hollowing out of the research and development divisions of most large companies that occurred over the last 50 years. A need exists for creative, innovative, and entrepreneurial people to tackle the existing problems encountered when transitioning from the drawing board to the factory floor and then on to the consumer. Once again it is the economy, or needs within the economy, that is driving the skills that should be developed via education and, to some extent, the enrollment patterns in higher education.

Corporations that once researched, designed, created, and manufactured products in-house have since stripped themselves down, in many cases, to sales operations, and shifted the other aspects of manufacturing and research overseas. Formerly known as "vertically-articulated corporations" (MIT, 2013, p. 25), these businesses drove employees' pursuit of higher levels of education with the promise of promotion through the various divisions of the corporation.

The changed structural landscape of corporations was not a result of education output. It resulted from changes to tax, labor, industrial, and monetary policies at the state and federal levels (Pierce & Schott, 2012). Off-shoring jobs to countries like Bangladesh, China, Pakistan, India, and Mexico had more to do with policies developed at the World Bank, World Trade Organization, and the International Monetary Fund, restructuring of U.S. corporations, and trade agreements like the North American Free Trade Agreement (NAFTA), than how 15 year-old children scored on the PISA mathematics test (Mullen et al., 2013; Pierce & Schott, 2012; Prestowitz, 2012, 2013).

Because research and development shifted from the corporate sector to the university and government sectors, it is now increasingly more difficult for small, innovative businesses to find help with problems associated with high technology manufacturing and production (MIT, 2013). The research and development supports for scaling up ideas that used to be part of the corporate landscape are no longer available in large quantities. Small and mid-sized firms seek creative, innovative, and entrepreneurial employees who can fill the void and solve problems in-house (MIT, 2013).

PISA, TIMMS, and the Economy

Results from previous studies on the relationships between ranks from international tests and economic output suggest that correlations can be statistically significant and moderately strong when all the small or weak economies like Denmark, Estonia, Hungary, Ireland, and Singapore remain in the sample with the G20 countries (e.g., Barro & Salai-Martin, 2003: Hanushek & Woessman, 2008). Whereas the relationship between international test ranks and economic strength can be weaker, non-existent, or negative when only the G20 economies, the largest economies in the world, form the sample (e.g., Baker, 2007; Rameriz, et al., 2006; Tienken, 2008).

Krueger and Lindhal (2001) found that countries with high levels of education attainment see no effect on national economic growth by incremental increases in the

populations' levels of classical education. This suggests that the knowledge economy does not grow via the 19th-century skills of computation and comprehension that the tests like PISA and TIMMS measure. The basic skills measured by international tests are not the competencies that will propel a large, developed economy forward (Auerswald, 2012; Zhao, 2012b).

What the Future Holds

Most of the crop of pre-school students from 2014 will enter the workforce between the years 2028 and 2034. Job market predictions by the U.S. Bureau of Labor Statistics (USBLS, 2012) are only forecasted 10 years into the future. This makes it difficult to project what the employment landscape might look like beyond that timeframe. However, given the growing trend in the U.S. and other highly industrialized countries of off-shoring routine jobs to the countries with the lowest wages and least protective regulations, we assume for the purposes of our study that skills and dispositions that are difficult to offshore—creativity, innovation, and entrepreneurship—will retain value when the classes of 2028 to 2034 enter the workforce. We are not alone in our assumptions.

The results from the 2012 Global Chief Executive Officer Study conducted by the IBM Corporation made recommendations for the skills necessary in the global innovation economy. The recommendations run counter to the skills assessed on the PISA and TIMSS tests and call into question the use of those results as indicators of students being prepared for the global economy. According to 1,700 CEO's representing 64 countries and 18 major industries, leaders and employees in the global economy must be able to innovate, collaborate and cooperate (globally, amongst themselves, and with their customer bases), be creative, seek opportunity, use complexity to a strategic advantage and be communicative.

The U.S. Council on Competitiveness (USCOC, 2007, 2012) cited innovation, entrepreneurship, flexibility, and creativity as key factors necessary to drive the U.S. economy in the future. Relative to its Competitiveness Index, the USCOC (2007) cited the United States as the global role model of an entrepreneurial economy.

If the skills identified by the leaders of some of the largest corporations in the world are valued today we believe they will be of value tomorrow because they are skills that transcend content, job category, and time. Zhao (2012a) warned that America is making the wrong bet by using results from international tests to drive standardization policies that mandate curricula and assessments that place a premium on the development and demonstration of routine academic skills, easily offshored to countries with lower wages or closer to the end user in the global supply chain.

Indices of Creativity, Innovation, and Entrepreneurship

Global Creativity Index

Since 2004, The Martin Prosperity Institute (MPI) (2011) has published the Global Creativity Index. A recent index (i.e., 2011) provides rankings for 82 of the world's countries, including all the industrialized member countries of the OECD (2013). The

index also includes members of the G20 group of nations. All the countries that one might consider as the United States' "competitors" are ranked by the index.

Researchers from the Institute compiled data from 2000-2009 relative to each country covering these areas of creativity: economic, social, and cultural. They developed three categories to describe creativity: technology, talent, and tolerance. Sub-domains within each category received a coefficient rating, and each category received a coefficient calculation; all three categories were used to arrive at an overall creativity coefficient for a country (MPI, 2011). The ratings from each of the three categories were then added and averaged for an overall Creativity score.

2013 Global Innovation Index

The Global Innovation Index (GII) is a multi-layered, multi-factor index used to rank the innovativeness of 142 countries (Cornell University, INSEAD, & WIPO, 2013). The overall GII is an average derived from the Innovation Efficiency Ratio (IER). IER is made up of the results from two sub-indices: Innovation Input and Innovation Output.

2012 Global Entrepreneurship and Development Index

The authors (Acs & Szerb, 2010; Acs, Szerb, & Autio, 2013) of the Global Entrepreneurship and Development Index (GEDI) endeavored to define entrepreneurship and provide a way to measure and present how much entrepreneurial capacity the majority of the countries in the world have and how much is operationalized. The authors measure entrepreneurship as the intersection of attitudes, actions, and aspirations.

Like the other two indices we used in this study, the GEDI is made up of sub-indexes for each of the three areas of entrepreneurship: entrepreneurial attitudes, entrepreneurial action, and entrepreneurial aspirations. A full explanation of the index and the calculation equation used can be found at http://www2.druid.dk/conferences/viewpaper.php?id=502261&cf=43 (Acs & Szerb, 2010).

Quantitative Methodology

We used a correlational design and conducted a series of two-tailed Spearman Rho correlation tests between ranks for participating G20 countries on the PISA 2000, 2003, and TIMSS 1995 math tests and ranks for indicators of creativity, innovation, and entrepreneurship. (See Tables 1 and 2.) Correlational designs allowed researchers to identify relationships among a set of variables. Statistically significant relationships can form the basis of future research. The most prominent limitation of such a design is that causality cannot be inferred.

We used rankings for the G20 countries from the (a) Global Entrepreneurship and Development Index (Acs & Szerb, 2010), (b) Global Creativity Index (MPI, 2011), and (c) Global Innovation Index (Cornell University, INSEAD, and WIPO, 2013). We set the level of statistical significance at the generally acceptable level in social science of $p < .05$ (Krathwohl, 2009).

Table 1
Absolute Ranks for G20 Countries on Mathematics Sections of the 1995 TIMSS, 2000 and 2003 PISA Tests

Country	TIMSS M 1995	PISA M 2000	PISA M 2003
Argentina	DNP	DNP	DNP
Australia	12	5	12
Brazil	DNP	31	40
Canada	14	6	7
China	DNP	DNP	DNP
France	9	10	16
Germany	15	20	19
India	41	DNP	DNP
Indonesia	DNP	DNP	39
Italy	DNP	26	31
Japan	3	1	5
Korea	2	2	2
Mexico	DNP	30	25
Russia	11	22	29
Saudi Arabia	DNP	DNP	DNP
South Africa	DNP	DNP	DNP
Turkey	DNP	DNP	34
United Kingdom	18	8	DQ
United States	20	21	28

DNP= Did not participate

We chose to cluster our sample on only the G20 countries, which represents 19 of the largest economies in the world, because it is somewhat methodologically deceiving to include all the counties that participated in the TIMSS or PISA testing into our sample (Tienken, 2008). Cluster sampling is appropriate when a homogeneous group exists in a larger population. In the case of the PISA population, students in more than 60 countries and cities took the test (Ahmed, 2009). Within the PISA population of countries, there exists a smaller sample of countries from the group of G20 nations. That subset is the focus of this study.

Small countries like Finland, Singapore, and Sweden have populations of less than 10 million people each and much smaller economies. In essence, they do not swim in the economic shark tank with the U.S. Their economies are much smaller than those in the G20. Smaller economies are not meaningful units (countries) in terms of competition for jobs, trade, or military advantages.

Correlations can be deceivingly positive when one includes all the countries that took the TIMSS or PISA because the smaller and poorer economies do tend to exhibit correlations between their test rankings and economic and industrial indicators (Tienken, 2008). Because there are many more countries with smaller economies than in the G20 group, the sample can be artificially pollinated to produce statistically significant relationships. In actuality, deceptive conclusions could be attributed to all countries in the

sample, like the ones Hanushek and Woessmann (2008) provided. However, when one clusters the analyses on the larger economies like the G20, the results can be different and fail to find meaningful relationships between rankings on PISA or TIMSS and economic indicators (Rameriz et al., 2006).

Table 2
G20 Ranks of Creativity, Innovation, and Entrepreneurship

Country	Creativity	Innovation	Entrepreneurship
Argentina	38	63	57
Australia	5	19	3
Brazil	46	64	81
Canada	7	11	2
China	58	35	47
France	15	20	13
Germany	15	15	17
India	50	66	88
Indonesia	81	85	68
Italy	19	29	50
Japan	30	22	36
Korea	27	18	33
Mexico	61	63	58
Russia	30	62	70
Saudi Arabia	76	42	29
South Africa	45	58	53
Turkey	68	68	40
United Kingdom	12	3	10
United States	2	5	1

Results and Discussion

A total of nine correlations among PISA and TIMSS rankings and three rankings of competitiveness in the knowledge economy failed to uncover any statistically significant relationships at the $p < .05$ level. The closest our correlational tests came to producing statistically significant results was between rankings of innovation and PISA2000 math at p=.063 and entrepreneurship and PISA2000 math p=.059.

The relationship between TIMSS1995 mathematics ranks and ranks on the Global Innovation Index was not statistically significant (p = .446). Likewise, the relationships to PISA2000 and PISA2003 ranks and innovation were p = .063 and p = .093, respectively. The relationships between rankings on the Global Entrepreneurship Index and rankings on the TIMSS1995, PISA2000, and PISA2003 were not statistically significant at p = .533, p = .059, and p = .132, respectively.

Finally, the relationships between the ranks of the Global Creativity Index and the TIMSS1995, PISA2000, and PISA2003were not statistically significant at p = .486, p =

.173, and p = .362, respectively. As one might expect, the three indices that represented competiveness attributes in the knowledge economy related strongly to each other and the relationships were statistically significant (see Table 3).

Table 3
Spearman Rho Correlation Coefficients among Ranks on International Math Tests and Competitiveness Indices with Significance in Parentheses

	Indices Correlations		
	Creativity	Innovation	Entrepreneurship
Math Tests			
TIMSS 1995	-.250 (.486)	-.273 (.446)	-.224 (.533)
PISA 2000	.421 (.173)	.552 (.063)	.559 (.059)
PISA 2003	.323 (.362)	.559 (.093)	.511 (.132)

Our findings of no statistically significant relationships between indicators associated with the innovation economy and TIMSS and PISA ranks align to the results from earlier studies of PISA and TIMSS results that suggest no statistically significant relationships or weak relationships between ranks on international tests and economic output indictors such as gross domestic product (GDP) adjusted gross income, or purchasing power parity exists (e.g., Baker, 2007; Rameriz, et al, 2006; Tienken, 2008).

Our findings also align with the criticisms that international tests do not provide meaningful information about the skills most important for full participation in society in terms of socio-civic and economic outcomes in the G20 countries (Sjoberg, 2007). The information tested on international tests is not the information children will need to compete in the innovation economy and the results do not tell us important information about student proficiency with the vocational competencies necessary to create, innovate, and pursue entrepreneurial opportunities (Zhao, 2014).

Extensions

Our results extend the discussion about the meaningfulness and usefulness of results from international tests in general for decision-making and policy making. They raise questions about the claims made by U.S. policymakers that the rankings on such tests provide important information about future economic success and changes that need to be made to the U.S. education system. The findings provide an expanded view of the lack of relationship between test ranks and economic strength via indicators of vocational competencies associated with the innovation economy.

If the results from two influential international tests do not relate to indicators of national economic strength or national indicators of important vocational economic competencies in the G20 countries, then large-scale policies and practices built upon the goal of improving results on such tests to improve economic competitiveness might be misguided. The results support the claim of Harbison and Myers (1956) that perhaps economics influences education output in the countries with the largest economies.

Decision Effectiveness

The results from our original study could provide school administrators with information to decide whether policies aimed at improving the global competitiveness of American students derived from PISA or TIMSS results are worth school administrators' time and resources to implement or how zealously they should pursue those types of policies.

The Common Core State Standards initiative provides an example of Vroom and Jago's (1988) model of decision effectiveness in action. The CCSS program was developed and marketed in part to improve student rankings on international tests. The NGA and CCSSO (2010) wrote on the Corestandards.org website that the Standards "are informed by other top performing countries, so that all students are prepared to succeed in our global economy and society" (About the Standards). The authors of the Common Core do not identify "top performing countries" individually by name, but they did use the rankings from the mathematics sections on the TIMSS and PISA tests to define a "top performing country." School administrators are left to guess what the cut-off ranking was to be considered a "top performing country" by the authors of the Common Core.

But what does being labeled as "top performing" mean in the context of our study? As the results from our Table 1 suggest, "top performing" on the TIMSS and PISA mathematics section is certainly no guarantee of having one of the largest 19 economies on the planet. The results from Table 3 suggest that "top performing" is also no guarantee of a country's adult population performing at high levels of creativity, entrepreneurship, and innovation.

A lack of communication about the technical quality of international tests, the content tested, and the lack of relationship between the rankings and vocational competencies valued in the 21st century innovation economy exists. The dire warnings made by education bureaucrats in the U.S. about stagnating education, based on results from PISA and TIMSS, do not hold up to scrutiny of the test results or the vocational competencies necessary for the global economy.

Administrator Decision Making

Hoy and Miskel (2013) describe the primary role of the school administrator as that of decision maker. Effective decisions require access to quality information. The information provided by the results from international tests, vis a vis the highly publicized league tables is misleading at best, and dangerous to school administrator decision making at worst (Zhao, 2014). The authoritative way in which the OECD and IEA authors present the results gives the sense of psychometric superiority, as if those who question the results are in some way misguided. But school administrators should be skeptical at first of the evidence they use to make important decisions until that evidence has been vetted and deemed valid for the decisions that will be made on behalf of children and teachers.

School administrator goal setting and decisions can be compromised if they do not have access to quality information about the policies and practices they are mandated to implement or choose to pursue. Pertinent, factually correct information is seemingly pushed underground in the mainstream information networks like professional journals,

media outlets, and professional organizations, making the decision-making situation even more precarious for school administrators.

At the very least, school administrators in G20 countries need to question the policies and practices foisted upon them by federal, state, and/or provincial education agencies and they should question the methods being used to determine effectiveness of the implementation of those policies. School administrators must dig below the surface to locate additional factually correct information for decision-making. Identifying the underlying philosophies and theories upon which bureaucrats build the various policies is a helpful first step.

Implications for Practice

Knowing the underlying philosophy or theory of a policy (e.g. essentialist, perrenialist, progressivist, behaviorist, and self-determination) can help the school administrator know how that policy could affect children and/or teachers downstream. For example, an achievement accountability policy derived from an essentialist philosophy of education will include aspects that centralize and standardize curriculum and assessment. If school administrators know the philosophies and theories that undergird the policies they develop and implement, and have access to some empirical literature regarding the efficacy of the policies, then they can better understand the weaknesses and strengths with those policies and take more appropriate actions to communicate the challenges and opportunities to stakeholders.

In the case of the Common Core Standards, the curricular philosophy that undergirds it is Essentialism. Essentialism derives from the ideas that a set of static core knowledge exists that all students must master with the same emphasis, at the same level of difficulty, in the same format, and within similar time periods regardless of student characteristics (Tanner & Tanner, 2007). Standardized tests are used to measure achievement of the static curriculum. Results from international tests of academic achievement are used along with state and nationally mandated tests to make determinations of student progress and corresponding policy proposals.

Essentialism rests in part on the idea that all children must master the same set of content and that some children have the ability to master the core subjects and some do not. Differences in the pace of human cognitive, social, and moral development does not play into the equation when determining which content would be most developmentally appropriate for certain students. Education under Essentialist control is autocratic and top down. Policies built upon Essentialist foundations have a dismal history of meeting the needs of all children in a democratic society (Tanner & Tanner, 2007).

Recommendations for Future Research

We suggest two primary avenues for future research:

1. Research what school administrators perceive about their school or district-based policies aimed at chasing international rankings. For this purpose, case studies could be conducted in order to offer perspective in the voices of the participants.

2. Identify the underlying philosophies and theories that guide how school leaders understand and respond to policies and how policymakers approach policy development. Investigate how school administrators think about policy development and whether they respond in like manner with a different or alternate theory or stance (e.g., teacher-led coaching model of teacher effectiveness, see Fletcher & Mullen, 2012).

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