

Literature Review of Sustainable K-12 Education Systems On a Global Scale

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Sunday, December 13 2015

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EDTC 804: Global Issues in Educational Technology Leadership

# SUSTAINABLE K-12 EDUCATION SYSTEMS ON A GLOBAL SCALE

## **Abstract**

This literature review presents background, definition, possible framework and studies related to sustainable K-12 education systems on a global scale. Throughout the research process for this review, it became apparent that the topic of sustainable school systems is one that lacks deep literature on the specific subject matter. This paper suggests that sustainability can be directly used in the field of education and should not be relegated to the field of ecology. As countries, focus on programmatic balance, equity and other socioeconomic aspects of education, developing sustainable school systems at scale should not be overlooked. Creating sustainable school systems at scale, can afford higher quality and equitable education to a great number of children around the world. A framework, common reform model and discussion of global successes and failures are presented to provide possible approaches to sustaining successful global school systems.

*Keywords:* Sustainability, Sustainable Systems, Reform, Framework, School Systems

### **Globalization and K-12 Education**

In the article, “Struggle For Smarts? How Eastern And Western Cultures Tackle Learning” author Alix Spiegel tells a story of the contrasts between western and eastern world education (Spiegel, 2012). Investments in education around the world are made in varying forms and amount. Nonetheless, the intended goal of these investments is to create effective schools and produce an educated society. Researchers argue that societies that invest in education, at certain levels, will not only gain high social return on investments (ROI), but high economic returns as well (Arnove, Torres, & Franz, 2012). This perceived social and economic ROI that education brings, drives educational pursuit and investment. This same social and economic ROI tends drives the pragmatic aspects of sustainable education we may see in both western and eastern worlds.

A core objective of education is to prepare students, ultimately the next generation of leaders, for future success. As the world becomes increasingly globally connected with the advancement of technology, schools must adapt and prepare students for this new globally connected world (Ghysels 2009). Both Western and Eastern countries face unique struggles to develop sustainable and effective school systems that prepare students that can compete within a global workforce. Educators in Eastern regions fear that their students, although above par in math and science globally, lack creativity and individuality (Spiegel, 2012). Conversely, while innovation, individuality and creativity are embraced in the western world, western educators find a system that

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under produces members of its society that excels in math, science and technology (Gold 2007).

Regardless of a region's location on the globe and educational practices, a focus on student preparedness is key to educational and national sustainability. Educators and researchers, suggest that, no one educational theory and practice provides a "one-size-fits-all" solution to attaining educational success (Arnove et al., 2012). However, it can be confidently stated that countries will continue to reform and adapt, while lending and borrowing ideas from each other, to improve national education and create sustainable school systems (Arnove et al., 2012). As countries, focus on programmatic balance, equity and other socioeconomic aspects of education, developing sustainable school systems at scale, should not be overlooked. Creating sustainable school systems at scale, can afford higher quality and equitable education to more children around the world.

### **History and Definition of Sustainable Schools**

The Merriam-Webster dictionary defines sustainability as: 1) able to be used without being completely used up or destroyed, 2) involving methods that do not completely use up or destroy natural resources and 3) able to last or continue for a long time (Merriam-Webster, 2015). Two of the three definitions provided in the official definition of sustainability are directed or indirectly related to the field of Ecology. As inferred from the aforementioned definition, sustainability is commonly used in the context of ecology and environmental systems. The term sustainability, as commonly known today, can be traced back to the 1987 report on the World Commission on Environment and Development: Our Common Future conference held in 1987 (Kuhlman & Farrington, 2010). In this report, major world leaders stressed the importance of

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focusing on global practices and policies that, controlled pollution, encouraged renewable energy development and development of sound businesses processes that positively affect the environment (WCED, 1987).

From the term's originating use in 1987, sustainability has had varying use, which at time leads to confusion and require clarification and framing (Kuhlman & Farrington, 2010). Sustainability was originally coined in forestry, where it means never harvesting more than what the forest yields in new growth. However, over time the term has evolved to not only be used in the context of ecology, but in politics, economy, business and education (Kuhlman & Farrington, 2010). To understand the overarching topic of sustainable school systems, as presented in this literature review, a clear definition of the term sustainable school systems is necessary to frame this research.

In 2005 the National Association of Independent Schools (NAIS), held a conference dedicated to the discussion of sustainable schools. During the 2005 conference, then president of NAIS, Patrick F. Bassett, shared the following regarding sustainable schools and the thoughts from a school leader:

*"My school's not interested in fads," one school head recently wrote regarding the conference theme. But our retort is this: while "sustainability," for some, may evoke a passing zeal for tree- hugging, we believe that all schools should, on a practical level, focus on "keeping up" and "prolonging" their own organizations. At the same time, they should be deeply interested in producing graduates capable of doing the same for their communities and for our world." (Bassett, 2005, p. 1)*

From the definition of sustainability presented by the Merriam-Webster dictionary and the varying use of the term, it is important to push a multi-dimensional use of the term sustainability. Although sustainability is commonly used in reference to environmental preservation, Bassett points out that sustainability implies keeping up and prolonging effective schools (Bassett, 2005). This means that the term sustainability can and should be used to refer to anything that can be sustained.

For the purposes of this review, a sustainable school system is framed as the ability for a school or education system to last or prolonged over a significant period. Furthermore, a sustainable school system is a product or measurement of successful educational projects, policies or reform. In this context, prolonged is a relative term. That is, sustainable school systems could last a period of three to five years, or more, depending on perspective. For example, Michael Fullan, suggest that elementary and secondary schools generally realize success in reform after three and six years, respectively (Fullan, 2000).

### **Sustained Excellence: Finland and Korea School**

Generally, creating successful and sustainable school is not a common or easy task. Similar to sustaining innovative educational technology, as discussed by Ronald Owston, there are many different factors and elements necessary for creating effective, high performing and sustainable schools, at a large scale (Owston, 2006). For over fifty years, The Organization for Economic Cooperation and Development (OECD) has worked with over 104 countries or non-member economies, to collect and analyze data to promote economic, prosperity and sustainable development (“What Is The OECD?”,

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2015). The field of education is a large part of OECD's data analyze and collection. The OECD provides a comparative account of data on learning outcomes, educational attainment, investment, participation and learning environments across the education systems of participating countries (Gorur, 2015). The OECD can be a valid source to compare and rank educational systems found around the world.

According to data extracted from 2003 and 2013 OECD statistical data, Finland, Korea, New Zealand and Ireland are four examples of countries that have maintained top ranking in graduation rates for all K-12 education programs in their countries. (*See Appendix I*) All of these countries have maintained impressive graduation rates for a number of years. The important question is how are these countries sustaining higher education achievement that others.

High educational achievement in both Finland and Korean is more about culture and less about money (Choi, 2014). According to the OECD, expenditure per student is a key policy measurement that most directly affects the individual learner, as it acts as a constraint on the learning environment in schools and learning conditions in the classroom (OECD, 2012). However, as you can see in appendix II, Korea is in the bottom half in terms of per-pupil spending while Finland is well above average. This suggests that there is not a direct relationship between cost per-pupil and the higher achievement Korea and Finland have realized.

In "What the Best Education Systems are Doing Right", Amy S Choi, argues that Korea's success model is based on grit and hard work. According to Choi, Korea is a the forefront of comparative test achievement, critical thinking and literacy because of 1) the pressure that is put on students, 2) the country's culture of diligence and hard, and 3) the

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studying children carry out year-around, both in school and with tutors (Choi, 2014).

While Choi attributes Korea's success to hard work, she attributes Finland's success to extracurricular choice, intrinsic motivation and school-centered model (Choi, 2014). Andreas Schleicher, an education surveyor, shared that data collected by the Programme for International Student Assessment (PISA) suggests that extracurricular activities may have direct links to performance. These extracurricular activities include, field trips, science fairs, and other clubs (Torgovnick May, 2013). Andreas Schleicher also notes that Finnish schools are the center of the community and provides not just educational services, but social services (Choi, 2014). The combination of a school-centered model, extensive extracurricular activities along with the high regard Finns have for the teaching profession may be the formula for educational success in Finland.

Similar to Amy Choi, Dani Thifa, author of "20 Best Education Systems Around the World", believes that a common factor shared among the top school systems around the world, is the high regard for effort. In her article, Thifa comprised a top-twenty list of the best school systems, which includes Finland, Korea and Belgium. Thifa's suggest that all of the top education systems, 1) prize effort above inherited ability, 2) have clear learning outcomes and goals, and 3) have a strong culture of accountability and engagement among a broad community of stakeholders (Thifa, 2015).

### **Challenging Regions: South America, France, and Detroit**

For each successful school system, one could identify multiple systems that have failed or are currently failing. Challenging or underperformed school systems can be found at the continent, country or state level. Additional challenges are found both in developed and underdeveloped regions. Nonetheless, there are a myriad of reasons that



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contribute to school system failures, regardless of locations. Social, economical, cultural or pragmatic aspects are common reasons cited for ineffective or unsustainable school systems.

Latin America currently has an education system that faces significantly lower performance and pressure for education improvement by local, state and national authorities (Chafuen, 2014). In 2012, PISA ranked almost every Latin America countries below the global average for participants. Chile in particular, scoring ten percent lower than the average, was the highest-ranking country in Latin America (PISA, 2012). (See *Appendix III*) Leaders of Latin America have identified economical factors as the leading cause of educational inequalities and lackluster overall academic performance by the region. Furthermore, leaders of the region like, Herald Beyer, push the government to help economically disadvantaged people by providing additional funding and merit-based scholarships (Crellin, 2012). By pushing the government to provide these economic resources, leaders look to afford people of low economic status the means to attain a quality education (Chafuen, 2014). Thus, improve lackluster educational performance.

Similar to Latin America, France also faces pressure by local communities and state government to improve its school system. According to the 2012 PISA report, France ranks near the bottom 50% fifty percent of participating countries in Mathematics, Reading and Science (PISA, 2012). (See *Appendix III*) France state government face pressures from parents to improve its education system after years of failing systems. Over the last fifteen years state-led education systems have led to falling academics and increasing social inequalities in France. With lackluster school performance and deteriorating schools, French parents want better educational options and alternatives for

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their children. Currently, new paid and free alternative schools are being created to give parents other education alternatives and students a better education (Gumbel, 2015).

Similar to the struggling Latin American countries and France, The United States also struggle with failing school systems. In particular, The Detroit's Public School (DPS) system is an example of failed education systems that continue to challenge a region. For the fourth year in a row, DPS ranked last in the National Assessment of Education Progress. The issues plaguing DPS systems are: ineffective administrators, poor financial performance, low academic standards, insufficient school choice, weak local control and inadequate governing bodies (Allen, 2015).

Tony Allen is President and CEO of Skillman Foundation. Since 1960, The Skillman Foundation has worked to improve the lives of Detroit children. The Foundation is organized to help create pathways for Detroit children to graduate from high school, and to be prepared for college, career, and life ("Who Are We", 2015). Allen made the following statement regarding the reform efforts of Detroit public school systems:

*"Sustaining Detroit's historic turnaround requires all of us to pull together to bring the city's schools back to national prominence. We can do this. " (Allen, 2015, p. 1)*

To turnaround Detroit Public Schools, the city and official look to reform efforts to achieve sustainable improvement in the city's school system.

### **Study of Sustainable School Systems Through Reform**

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Promoting sustainable school systems in the context of this review requires a multi-faced framework that identifies key components of education systems that are necessary for prolonged success. As shown in the two preceding sections, many unique components produce or prevent successful school systems. Identifiable components that promote sustainable schools could include: financial, environmental, global, programmatic, administrative, innovative and demographical sustainability, among others (Bassett, 2005). Achieving success in these areas on a large scale may require radical approaches. Anthony S. Bryk and Barbara Schneider suggested that improving schools require us to think harder about how best to organize the work of adults and students so that the connective tissue of the school system remains healthy and strong (Bryk & Schneider, 1990). School reform can take many forms, approaches and strategies, all with the intention to improve school systems. Three commonly used reform approaches are standards-based reform, comprehensive school reform and student-centered reform (Silver, 2004).

One of the most common forms of school system reform is Comprehensive School Reform (CSR). CSR refers to approaches to improving outcomes in the entire school system. According to Robert Slavin, research professor for the University of York, CSR sees the school as the primary unit of change in education. It seeks to implant effective practices in all of the central areas of school functioning most likely to affect student achievement: Curriculum, instruction, assessment, grouping, accommodations for struggling students, parent and community involvement, school organization, and professional development (Salvin, 2007). Essentially, CSR works to address the entire school system to affect lasting change.

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Towards the end of the 20<sup>th</sup> century, the United States made a committed to attain eight educational goals by the year 2000. One major measurable goal set was goal 3: All students will leave grades 4, 8 and 12 demonstrating competency over challenging subject matter (Goldenberg, 2004). According to the 2000 OCED report, nearly 60% of United State students were rated at a basic or below reading literacy level based on data collected from 41 participating countries. (OCED, 2000) (*See Appendix IV*) Not surprisingly, countries such as Finland, Korea, Japan and Belgium stood atop the list. With bleak data from the OCED 2000 report, it can be argued that the United States, like many other countries, failed to meet its educational goal. Failure to meet educational goals through reform, policies and goal setting has been a reoccurring theme for the United States, countries in South America and other countries around the world. An important question is why are these countries, both big and small, failing to find sustainable scalable education success.

### **Creating Sustainable Schools: A Possible Framework**

Michael Fullan argues in “The Three Stories of Education Reform” that sustainable change is not possible unless there is a strong combination of: 1) systems and education culture inside the schools, 2) effective collaboration with outside forces and 3) support of outside agencies such and local and state governments (Fullan, 2000).

### **Inside Theory**

The idea behind the inside effect of the school system, which Fullan presents, is that schools with a culture grounded on strong collaboration, data decision-making and iterative processes, tend to do better, in terms of student performance than schools that do not (Fullan, 2000). For example, Karen Louis and Matthew Miles carried out a study of

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the leadership and management skills needed to improve urban schools. Luis and Miles examined 178 principals in urban schools that were conducting improvement practices for four or more years. Through this research, Louis and Miles found that collaborative planning, concerted problem solving, effective communication among schools and districts, cross-role teamwork and shared visions of what the school is to become are necessary components for success inside the school (Louis & Miles, 1990).

### **Inside-Outside Theory**

A growing trend in effective school reform and restructuring is to acknowledge and ultimately understand the importance of uniting both the internal and external supports of schools (Conti, Ellsasser & Christopher, 2000). With continued increases in community engagement, global communication and access to information around the world, made possible via the Internet and other technologies, schools have greater access to a wealth of outside resources. Fullan, argues that technology, parents and community, corporate connections, government policies and a wider teacher profession have changed the effect outside factors have on schools (Fullan, 2000). Fullan suggests that outside forces create more permeable and transparent schools. Fullan further suggests that outside forces catalyzes increasing accountability, higher standards and ultimately greater pressure inside schools (Fullan, 2000). Ultimately, success can be found in school systems that devise ways to embrace and use these outside forces to enhance or improve inside aspects and systems.

Understanding the relationships between inside objectives of a school and outside communities or cultures, along with their effects on school success, is also discussed by Christine Finnan, in “Implementing School Reform Models: Why Is It So Hard For Some

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and Easy For Others”. Finnan concludes that when a match between the cultures of the school community (administrators, teachers, staff and parents) exists the reform is more likely to be successfully implemented (Finnan, 2000). Additionally, Finnan’s conclusion suggests that, misaligned agendas or expectations between the school and community, is likely to produce failed or unsustainable school reform systems.

### **Outside-Inside Theory**

The first most significant wave of school improvement efforts in the United State was sparked by the Sputnik-Era and fears of the United State falling behind other nations. These fears sparked the rollout of more challenging standards for school to improve performance (Conti et al., 2000). This first wave of reform is largely considered a failure. As aforementioned data from OECD and PISA shows, the United State has struggled to sustain and create effective education on a nation scale over the last fifty years. Fullan suggests that there is more known about small school success than large district and systematic success. However, although the formula to sustain large-scale success is less known, Fullan points to the understanding of centralization, decentralization and their affect on local and national education polices to help fill the knowledge gap (Fullan, 2000). Large-scale improvement and sustainability in academic learning require consistency instructional practices across multiple schools, although schools may confront very different conditions (Elmore & Burney, 1997). Understanding outside factors such as centralization and decentralization may allow for better planning and policies that create consistency across schools and ultimately sustainable school systems, at a large scale.

### **Affects of Centralization or Decentralization**

When thinking about sustainable school systems, the impact of government and how changes are made are important components to take into consideration. Michael Fullan argues that both centralization and decentralization are required to afford large-scale success of school systems. A balance has to be met for both centralization and decentralization to work in concert with one another and positively affect school systems. Similar to Christine Finnan's conclusion, as mentioned above, schools need the ability to create effective education specific to its location, culture and need (Finnan, 2000). If centralization is too dominant, local policies may be stifled and schools may lack the ability to make the necessary educational adjustments needed for meaningful changes inside the classroom. Likewise, if decentralization is dominant, schools may have the ability to make changes and develop systems that positively impact a single school or district, but lack the governmental, political and financial power necessary to lead to a larger more sustainable scale (Fullan, 2000).

Fullan's argument parallels the affect of the autonomous and the heteronomous model of educational development being realized by universities in developing countries around the globe. A university that follows an autonomous model is in contrast to one that holds a heteronomous model. Autonomy states that one has relatively great control. Whereas, the heteronomous model implies subordination to outside bodies and laws (Arnove et al., 2012). In the past, universities held a more autonomous approach to developing curriculum and approaches. With an autonomous model, universities could create an educational environment that was free from outside influences and focus more on catering to specific academics, ideas and educational goals. Conversely, a

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heteronomous model is created when the mission, strategy and agenda of a university are driven by outside forces (Arnove et al, 2012).

Similar to centralization and decentralization, autonomous and heteronomous models produce different challenges and advantages to developing sustainable education systems. In a centralized model, more autonomy is given to the local institutions to make necessary system changes. However, as Fullan argues, singular institution may lack the power necessary for large-scale sustainability (Fullan, 2000). Conversely, a heteronomous model may limit the power institutions have to make local system changes. However, greater ability to enforce more large-scale change may be possible through powerful heteronomous control. Regardless of the model being used by an institution to achieve sustainable changes, it is important understand the landscape and the affect centralization or decentralization may present.

### **Conclusion**

The topic of sustainable school systems is one that lacks deep literature on the specific subject matter. The lack of specific literature on sustainable education systems may be due to the notion that the term sustainability is relegated to the field of ecology and environmental science. As this literature review shows, sustainability can be directly used in the field of education and should not be relegated to the field of ecology.

Although the term sustainability has varying definitions, we should also view sustainability in terms of sustaining effective school systems. It is important to understand sustainable education systems in terms of our global economic and social ROI. Consistently successful school systems, as found in Korea, Finland and Belgium, can provide high economic and social ROI with successful replication in other regions



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around the globe. However, as this literature review suggests, there are many different economic, culture and social factors specific to a region that prevent a “one-size-fits-all” approach to global education success (Arnove et al, 2012).

To improve the possibilities of developing sustainable school systems, a blueprint or framework, as presented by Michael Fullan can be an ideal starting point. Michael Fullan’s three-part framework, which takes a comprehensive school reform approach, could produce more sustainable school systems, if implemented logically and strategically (Fullan, 2000). Ultimately, as this literature review shows, many factors cause successful and unsuccessful school systems. With deeper research, greater conversations and more defined frameworks, sustainable school systems can be created to improve education across the globe.

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## Appendix I: OECD Countries 2005 and 2013 Graduation Rates

OECD Graduation Rates: 2005 Upper Secondary: All Education Programs				OECD Graduation Rates: 2013 Upper Secondary: All Education Programs			
Rank	Country	Percentage	Above/Below	Rank	Country	Percentage	Above/Below
1	Czech Republic	115.6	35%	1	Portugal	100.9	17%
2	Japan	95.3	15%	2	New Zealand	100.7	17%
3	Greece	95.2	15%	3	Ireland	97.9	14%
4	Finland	93.7	13%	4	Finland	96.2	12%
5	Korea	92.1	12%	5	Denmark	95.1	11%
6	Ireland	92	11%	6	Switzerland	95.1	11%
7	Norway	90	9%	7	Korea	92.4	8%
8	New Zealand	87.8	7%	8	Israel	90.9	7%
9	Slovak Republic	85.6	5%	9	Austria	87.5	3%
10	Slovenia	84.8	4%	10	Poland	86.5	2%
11	Italy	84.6	4%	11	Chile	86.4	2%
12	Denmark	83.3	3%	12	Canada	85.6	2%
13	Chile	81.1	1%	13	Slovenia	85.5	1%
14	Canada	80.2	0%	14	Slovak Republic	85.3	1%
15	United States	74.3	-6%	15	Hungary	83.4	-1%
16	Luxembourg	72.1	-8%	16	United States	79.7	-4%
17	Spain	69	-12%	17	Sweden	79.5	-5%
18	Portugal	53.6	-27%	18	Italy	77.7	-6%
19	Poland	41.4	-39%	19	Czech Republic	77.6	-6%
20	Mexico	40.2	-40%	20	Norway	74.9	-9%
	<b>Average</b>	<b>80.595</b>		21	<b>Luxembourg</b>	72.9	-11%
				22	<b>Spain</b>	71.1	-13%
				23	Turkey	63.5	-21%
				24	<b>Mexico</b>	51.2	-33%
					<b>Average</b>	<b>84.0625</b>	

Source: OECD 2005 and 2013 Statistical Database

## Appendix II: OECD 2012 Per Pupil Spending Analysis

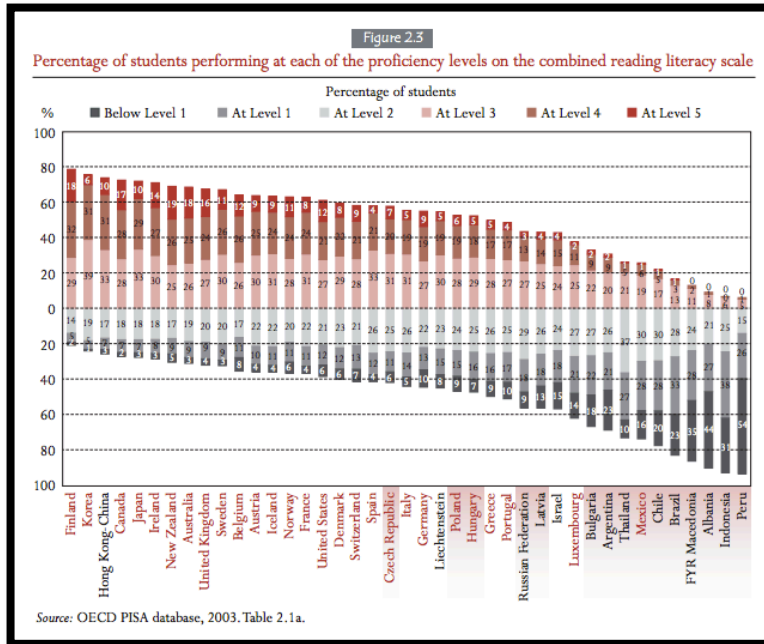
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OCED Per Pupil Spending (OCED 2012)			
Rank	Country	PPP	Above/Below Average
1	Luxembourg	\$ 19,178.10	\$ 11,737.41
2	Norway	\$ 13,612.00	\$ 6,171.31
3	Austria	\$ 11,672.70	\$ 4,232.01
4	Denmark	\$ 11,005.90	\$ 3,565.21
5	United States	\$ 10,794.30	\$ 3,353.61
6	Sweden	\$ 10,651.90	\$ 3,211.21
7	Belgium	\$ 10,597.50	\$ 3,156.81
8	Finland	\$ 9,282.70	\$ 1,842.01
9	Iceland	\$ 8,956.20	\$ 1,515.51
10	Netherlands	\$ 8,886.10	\$ 1,445.41
11	Japan	\$ 8,851.20	\$ 1,410.51
12	Germany	\$ 8,518.00	\$ 1,077.31
13	France	\$ 8,478.40	\$ 1,037.71
14	United Kingdom	\$ 8,427.50	\$ 986.81
15	Australia	\$ 7,971.10	\$ 530.41
16	Slovenia	\$ 7,919.80	\$ 479.11
17	Italy	\$ 7,659.10	\$ 218.41
18	Korea	\$ 7,342.50	-\$ 98.19
19	Spain	\$ 7,128.40	-\$ 312.29
20	New Zealand	\$ 6,967.20	-\$ 473.49
21	Portugal	\$ 6,604.70	-\$ 835.99
22	Estonia	\$ 6,244.20	-\$ 1,196.49
23	Israel	\$ 6,122.40	-\$ 1,318.29
24	Czech Republic	\$ 5,838.70	-\$ 1,601.99
25	Poland	\$ 5,636.30	-\$ 1,804.39
26	Russia	\$ 5,167.20	-\$ 2,273.49
27	Slovak Republic	\$ 4,609.80	-\$ 2,830.89
28	Hungary	\$ 4,116.00	-\$ 3,324.69
29	Latvia	\$ 3,470.40	-\$ 3,970.29
30	Chile	\$ 3,408.30	-\$ 4,032.39
31	Turkey	\$ 2,377.40	-\$ 5,063.29
32	Mexico	\$ 2,319.90	-\$ 5,120.79
33	Colombia	\$ 2,071.30	-\$ 5,369.39
34	Indonesia	\$ 1,096.30	-\$ 6,344.39
	<b>OECD - Average</b>	<b>\$ 7,440.69</b>	<b>\$ -</b>

Source: OECD 2012 Statistical Database

### Appendix III: OECD 2000 Reading Literacy Proficiency Ranking

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Source: OECD 2000 "At A Glance Report"

## Appendix IV: 2012 PISA Mathematics, Reading and Science Results

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	Mathematics				Reading		Science	
	Mean score in PISA 2012	Share of low achievers in mathematics (Below Level 2)	Share of top performers in mathematics (Level 5 or 6)	Annualised change in score points	Mean score in PISA 2012	Annualised change in score points	Mean score in PISA 2012	Annualised change in score points
OECD average	494	23.0	12.6	-0.3	496	0.3	501	0.5
Shanghai-China	613	3.8	55.4	4.2	570	4.6	580	1.8
Singapore	573	8.3	40.0	3.8	542	5.4	551	3.3
Hong Kong-China	561	8.5	33.7	1.3	545	2.3	555	2.1
Chinese Taipei	560	12.8	37.2	1.7	523	4.5	523	-1.5
Korea	554	9.1	30.9	1.1	536	0.9	538	2.6
Macao-China	538	10.8	24.3	1.0	509	0.8	521	1.6
Japan	536	11.1	23.7	0.4	538	1.5	547	2.6
Liechtenstein	535	14.1	24.8	0.3	516	1.3	525	0.4
Switzerland	531	12.4	21.4	0.6	509	1.0	515	0.6
Netherlands	523	14.8	19.3	-1.6	511	-0.1	522	-0.5
Estonia	521	10.5	14.6	0.9	516	2.4	541	1.5
Finland	519	12.3	15.3	-2.8	524	-1.7	545	-3.0
Canada	518	13.8	16.4	-1.4	523	-0.9	525	-1.5
Poland	518	14.4	16.7	2.6	518	2.8	526	4.6
Belgium	515	19.0	19.5	-1.6	509	0.1	505	-0.9
Germany	514	17.7	17.5	1.4	508	1.8	524	1.4
Viet Nam	511	14.2	13.3	m	508	m	528	m
Austria	506	18.7	14.3	0.0	490	-0.2	506	-0.8
Australia	504	19.7	14.8	-2.2	512	-1.4	521	-0.9
Ireland	501	16.9	10.7	-0.6	523	-0.9	522	2.3
Slovenia	501	20.1	13.7	-0.6	481	-2.2	514	-0.8
Denmark	500	16.8	10.0	-1.8	496	0.1	498	0.4
New Zealand	500	22.6	15.0	-2.5	512	-1.1	516	-2.5
Czech Republic	499	21.0	12.9	-2.5	493	-0.5	508	-1.0
France	495	22.4	12.9	-1.5	505	0.0	499	0.6
United Kingdom	494	21.8	11.8	-0.3	499	0.7	514	-0.1
Iceland	493	21.5	11.2	-2.2	483	-1.3	478	-2.0
Latvia	491	19.9	8.0	0.5	489	1.9	502	2.0
Luxembourg	490	24.3	11.2	-0.3	488	0.7	491	0.9
Norway	489	22.3	9.4	-0.3	504	0.1	495	1.3
Portugal	487	24.9	10.6	2.8	488	1.6	489	2.5
Italy	485	24.7	9.9	2.7	490	0.5	494	3.0
Spain	484	23.6	8.0	0.1	488	-0.3	496	1.3
Russian Federation	482	24.0	7.8	1.1	475	1.1	486	1.0
Slovak Republic	482	27.5	11.0	-1.4	463	-0.1	471	-2.7
United States	481	25.8	8.8	0.3	498	-0.3	497	1.4
Lithuania	479	26.0	8.1	-1.4	477	1.1	496	1.3
Sweden	478	27.1	8.0	-3.3	483	-2.8	485	-3.1
Hungary	477	28.1	9.3	-1.3	488	1.0	494	-1.6
Croatia	471	29.9	7.0	0.6	485	1.2	491	-0.3
Israel	466	33.5	9.4	4.2	486	3.7	470	2.8
Greece	453	35.7	3.9	1.1	477	0.5	467	-1.1
Serbia	449	38.9	4.6	2.2	446	7.6	445	1.5
Turkey	448	42.0	5.9	3.2	475	4.1	463	6.4
Romania	445	40.8	3.2	4.9	438	1.1	439	3.4
Cyprus <sup>1,2</sup>	440	42.0	3.7	m	449	m	438	m
Bulgaria	439	43.8	4.1	4.2	436	0.4	446	2.0
United Arab Emirates	434	46.3	3.5	m	442	m	448	m
Kazakhstan	432	45.2	0.9	9.0	393	0.8	425	8.1
Thailand	427	49.7	2.6	1.0	441	1.1	444	3.9
Chile	423	51.5	1.6	1.9	441	3.1	445	1.1
Malaysia	421	51.8	1.3	8.1	398	-7.8	420	-1.4
Mexico	413	54.7	0.6	3.1	424	1.1	415	0.9
Montenegro	410	56.6	1.0	1.7	422	5.0	410	-0.3
Uruguay	409	55.8	1.4	-1.4	411	-1.8	416	-2.1
Costa Rica	407	59.9	0.6	-1.2	441	-1.0	429	-0.6
Albania	394	60.7	0.8	5.6	394	4.1	397	2.2
Brazil	391	67.1	0.8	4.1	410	1.2	405	2.3
Argentina	388	66.5	0.3	1.2	396	-1.6	406	2.4
Tunisia	388	67.7	0.8	3.1	404	3.8	398	2.2
Jordan	386	68.6	0.6	0.2	399	-0.3	409	-2.1
Colombia	376	73.8	0.3	1.1	403	3.0	399	1.8
Qatar	376	69.6	2.0	9.2	388	12.0	384	5.4
Indonesia	375	75.7	0.3	0.7	396	2.3	382	-1.9
Peru	368	74.6	0.6	1.0	384	5.2	373	1.3

Source: OECD, PISA 2012 Database; Tables I.2.1a, I.2.1b, I.2.3a, I.2.3b, I.4.3a, I.4.3b, I.5.3a and I.5.3b

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