

Report and Recommendations for Education Policy Leaders

from **The Pearson Foundation/CCSSO
International Conference on Science
and Mathematics Education**

Singapore, April 28–May 1, 2008





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Bevin Kennedy, Contributor, CCSSO
Jennifer Manise, Contributor, CCSSO
Scott Montgomery, Coordinator, CCSSO





Foreword

In the spring of 2008, the Council of Chief State School Officers and the Pearson Foundation together welcomed educators from 13 countries and six continents to Singapore for the inaugural Pearson Foundation/CCSSO International Conference on Education.

The first gathering, focused specifically on science and mathematics, was convened deliberately in Singapore in the hope that this worldwide delegation could learn from Singapore's success in these disciplines. This small city-state realized 25 years ago that its greatest natural resource was its citizens, identified education as the key to success, and embarked on a radical reconstruction of its education system. Today, Singapore produces some of the most consistently prepared students in science and mathematics.

Our goal was to see firsthand the educational and cultural drivers of this achievement, and to learn more about other countries' approaches to developing and delivering quality science and mathematics education. We visited the Singapore National Institute of Education, where all Singapore education leaders and teachers are trained, and the Crescent Girls' School, which is a model of the country's outstanding student achievement.

Today's world is complex. Countries are interconnected as never before, and students face new challenges and choices. Today's students must compete in a global economy. Their skills in science and mathematics must match those of their peers around the world. They need proficiency in 21st century skills such as problem-solving and media literacy in addition to core academic subjects.

As leaders of business and education policy, we recognize that improving education systems is a formidable process that involves societal values and expectations as well as schools. We know that previously held assumptions and basic structures must often be changed. We brought with us many questions, including:

- Why is preparing today's students more complicated than in the past?
- What common issues are societies struggling with despite size differences or cultural divides?
- What practices are succeeding?
- What necessitates groundbreaking change?
- What elements of successful smaller systems, if any, can be replicated on a larger scale?
- What elements of the Singapore education system can be utilized elsewhere?

We gained numerous insights, developed more questions, and left ready to tackle new challenges at home. Several themes emerged, including the importance of:

- Ongoing system alignment through strategic planning
- Educator investment
- A rich educational community
- Strong content and pedagogy
- Professional development
- Disciplined education communities
- Core curricular content
- Contextual variances
- High expectations
- Lifelong learning opportunities
- 21st century skills
- Connecting practice with research (a tenet of Singapore's National Institute of Education)

Our spirited discussions in Singapore set the stage for continued exploration of these issues – an exploration we invite others to share by means of this document and the accompanying video presentation of our experience.

Sincerely,

Gene Wilhoit
Executive Director
Council of Chief State School Officers

Steve Dowling
President
Pearson, Inc.



Table of Contents

Introduction	1
Singapore	2
Achievements	2
History	2
Society	2
Education System	2
Teaching Profession	3
21 st Century Skills	3
Site Visit: Crescent Girls' School	4
Site Visit: National Institute of Education	4
Other Countries	5
New Zealand	5
Malaysia	5
Canada	5
South Africa	5
England	5
Lessons Learned and Best Practices	6
Systemic Alignment through Strategic Planning	6
Investment in Teachers	6
Investment in Leadership	7
Curriculum	8
Recommendations	9
Review Your Education System and Examine Your Structure	9
Invest in Quality Educators	9
Review Your Curriculum	10
Conclusion	10
Participants	11
Acknowledgments	12

Introduction

Around the world, educators understand the importance of strong science and math instruction and the need to ensure equally strong student comprehension and performance in these disciplines. Chief among these efforts is the common struggle to make curricula and careers in science and mathematics more relevant to students and also more responsive to the demands of the local and increasingly interconnected global economies. Despite best efforts, many countries' scores remain flat, and achievement gaps linger.

However, several countries, particularly some in the Pacific Rim, are finding innovative ways to close the gaps and improve student achievement. It was for this reason that Singapore, where early dramatic improvements and consistent top performance in science and math have been closely chronicled and researched for the past 20 years, was selected as the location for our global exploration of these issues.

The goals of our gathering were to:

- Investigate and learn from the advancements of Singapore in science and math education
- Explore practice by conducting a site visit to a top-performing school in Singapore
- Visit Singapore's only teacher training institute to explore its methodologies for preparation and professional development
- Explore innovative practices in science and math education in other systems from around the world

The delegates brought together Pk–16 education expertise from Singapore, South Africa, Hong Kong, Korea, and Taiwan; state-level expertise from Sao Paulo, Brazil, and from four U.S. states (South Dakota, California, Georgia, and West Virginia); national system perspectives from England, Italy, South Africa, Malaysia, Canada, and New Zealand; the local system perspective of Japan; and the global perspective of Pearson Education.

According to international comparisons, students in many of these countries – notably Singapore, England, and Canada – score higher in science and math than do their peers in the U.S., so a major goal was to understand the challenges and share the best practices from these systems. These practices – and the systemic goals and ambitions that support them – were of particular interest to the Pearson Foundation and to representatives from Pearson Education, which helped to bring the representatives from each country together and contributed insights from a worldwide perspective.



Singapore

Achievements

In a country of more than four million inhabitants, about 530,000 students were enrolled in primary and secondary school in 2006. Almost 87 percent of students passed their “O levels” (high examination in secondary school), and almost every student went on to a two-year college, four-year college or university, or a technical/polytechnic program after secondary school.

Singapore has one of the highest literacy rankings in the world as measured by the Progress in International Reading Literacy Study (PIRLS)¹ and leads the world in achievement in science and math in fourth and eighth grade on the Trends in International Mathematics and Science Study (TIMSS).² In April 2008, Singapore was rated the best-performing education system in the study “How the World’s Best-Performing School Systems Come Out on Top” by McKinsey & Company.³

History

These achievements have taken place within the last 25 years. The Republic of Singapore is a young country that was officially established in 1965 and faced many issues after gaining independence from Great Britain and seceding from Malaysia, including a lack of employment, housing, and natural resources.

After Lee Kuan Yew became prime minister in 1959, the country began to recognize the need to invest in its only natural resource, its people. During the last decade of Lee’s term, education reform was initiated as a critical component of the national agenda. His son now carries on that legacy.

Society

Singapore is now a highly developed market economy and one of the busiest ports in the world. As of September 2007, the unemployment rate was 1.7 percent, the lowest in a decade. The population as of 2008 was 4.84 million, of whom 3.64 million were Singaporean citizens and permanent residents. Various Chinese ethnic groups formed 75.2 percent of Singapore’s residents, Malays 13.6 percent, and Indians 8.8 percent, while Eurasians and other groups formed 2.4 percent. Thousands of foreign expatriates work in multinational corporations.

“What kind of society do we want?... Is our system of values and culture at the expense of a commitment to a strong fundamental understanding? Is it excellence versus equity? How do we raise the bar and close the gap?”
—Dr. Fred Renihan, Canada

Education System

The Singapore education system is a single nationally unified system that manages all teacher training, hiring, and placement. In addition, the Ministry of Education (MOE) manages curriculum development, national assessment, and placement of some students.

As a small country, Singapore has been able to take advantage of numerous streamlining opportunities, but its education system is not without some controversy. Students are streamed in the early grades, and streaming of lower-performing students is now being phased out due to some domestic criticism.⁴ However, educators in Singapore also point to the streaming system’s many flexible pathways to student success, recognition of diverse abilities, and ability to move students from one track to another.

¹ National Center for Education Statistics; <http://nces.ed.gov/Surveys/PIRLS/>

² National Center for Education Statistics; <http://nces.ed.gov/timss/results03.asp>

³ McKinsey & Company; http://www.nationalschool.gov.uk/policyhub/news_item/schools_mckinsey08.asp

⁴ International Review of Curriculum and Frameworks Internet Archive; <http://www.inca.org.uk/1034.html>

Assessment is used regularly within the Singaporean system. Both formative and summative measures are regular tools of teachers, and formative assessment takes place daily within the classroom.

Children in Singapore benefit from at least 10 years of general education – six years of compulsory primary education and four years of secondary education. Children who pass the Primary Six Leaving Examination (PSLE) progress to secondary schools – secondary 1 through secondary 4 or 5 – somewhat similar to seventh through tenth grade in the U.S. system.

Students who pass the General Compulsory Exam (GCE) O-level examination at the end of secondary 4 or 5 then compete for admission to either a junior college (two years), a polytechnic (three or four years), or a pre-university center (three years) – somewhat similar to eleventh and twelfth grade in the U.S. system.

Candidates who pass at least one subject at A-Level or AO-Level in the GCE A-Level Examination receive a General Certificate of Education (Advanced Level). Candidates who fail a subject at A-Level may be awarded a pass at AO-Level in that subject if they have reached a certain standard in the subject.⁵

Students who do not perform well in the O levels have various options. If they meet the age requirements, they may retake the O levels in their former school or as a private candidate, or they may further their education in Institute of Technical Education (ITE) schools or private schools provided they meet the entry requirements.

Students who pass the GCE A-level examination at the end of junior college year 2 or pre-university year 3, and students with excellent results at the end of polytechnic year 3 or 4, then compete for admission to a local university, either National University of Singapore or Nanyang Technological University.⁶

Teaching Profession

Though education was made compulsory only within in the past decade in Singapore, the long-term societal commitment to education has been very influential. The teaching profession is honored and valued. Teachers are compensated at a level equal to other professions seeking top talent – including engineers, scientists, and others.

Obtaining a spot in a teacher-training program is highly competitive, because only the top third of secondary school graduates are eligible to apply. Educator training is centralized through the MOE, and students are given a living stipend during their time at the National Institute of Education (NIE). Hiring, management, and professional development for educators and school administrators are all managed by the MOE.

21st Century Skills

Singapore has adopted a “Teach Less, Learn More” (TLLM) campaign to encourage contextual self-motivated learning. By investing in training and support for well-qualified educators, the education system has been able to place a strong emphasis on this type of integrative learning in the classroom. When entering the classroom for the first time, well-trained teachers are able to draw on solid content knowledge along with an emphasis on higher-order thinking and other 21st century skills.

Teachers emphasize self-made connections and teach advanced problem-solving skills, even in the early grades. This is clearly a major factor in the country’s leading position in science and math education. Although the curriculum is streamlined and minimalist, teachers are trained to prepare their students to problem solve and move fluidly between related concepts – skills that are needed in science and math as well as in business and many other careers that await students in the 21st century economy.

⁵ Singapore Examinations and Assessment Board; <http://www.seab.gov.sg/SEAB/aLevel/certificateStatement.html>

⁶ Singapore Ministry of Education overview; <http://www.moe.gov.sg/education/>

In addition, the Singapore education system strongly emphasizes ethics and attitudes for every student and teacher – what we in the U.S. would call “character education.” There is a deep societal commitment to creating compassionate students with an authentic concern for each other, for their communities, and for their environment. The MOE even outlines the specific set of ethical and leadership expectations within each level of the system.⁷

Site Visit: Crescent Girls’ School

The Crescent Girls’ School (CGS), one of the highest-performing schools in Singapore, was incorporated in 1956 and became autonomous in 1996, which gave the leadership more funding and greater independence in making strategic decisions and forging partnerships.

In 2003, CGS became a Microsoft School of the Future and solidified its commitment to innovation and technology throughout the curriculum and the classroom, including a 1:1 tablet personal computer ratio. In addition to traditional classrooms, students enjoy indoor and outdoor laboratories and studios for the arts, 3-D animation, and theater. The portfolio of assessment measures includes community service projects, investigative learning inside and outside the classroom, and the national tests.

The Crescent Girls’ School has channeled its resources into an instructional program that is authentic and relevant to the needs of its students. The curriculum goes beyond the academics required for national examinations and motivates students to be self-directed, voracious learners with well-developed skills in the areas of analytical thinking, decision-making, and problem-solving – skills that are needed in all educational and workplace settings. The emphasis on curriculum, skills, and technology has paid off. Crescent Girls’ School graduates have gone on to become teachers, entrepreneurs, writers, lawyers, and CEOs.

Site Visit: National Institute of Education

The National Institute of Education is the sole institution responsible for educating teachers, administrators, and para-educators in Singapore. It plays a very significant role in the country’s education system. The NIE director, Professor Lee Sing-Kong, enthusiastically conveyed the NIE’s belief that education involves the transformation of the mind and heart and is always worth the investment.

The NIE prepares new teachers, provides ongoing professional development to existing teachers and school leaders, and conducts extensive educational research. Upon graduation, the new teacher is *de facto* certified.

The NIE has more than 400 academic staff members, of whom 72 percent hold PhDs, 23 percent master’s degrees, and 5 percent bachelor’s degrees or professional qualifications. The NIE enrollment in June 2007 was 5,610 full-time-equivalent students, 69 percent of whom were female and 31 percent male.

Initial teacher preparation programs include Diploma in Education, Bachelor of Arts/Bachelor of Science (Education), and Postgraduate Diploma in Education. The NIE also offers Master of Arts and Master of Science as well as Doctor of Philosophy and Doctor in Education degrees. Continuing education and professional development courses are comprehensive and continually changing to reflect teachers’ needs.

“The Ministry of Education works very closely with every other ministry and enables children to discover their own talents, to make the best of these talents and realize their full potential, and to develop a passion for learning that lasts through life. The vision for meeting the challenges for the future can be summed up as Thinking Schools, Learning Nation – a vision for Singapore to become a nation of thinking and committed citizens, conscious of their responsibilities to family, society, and country.”

—“Teach Less Learn More,” Ministry of Education, Singapore

⁷ For more information visit Ministry of Education, Singapore Desired Outcomes; <http://www.moe.gov.sg/education/desired-outcomes/>, retrieved July 20, 2008

Other Countries

Representatives from several other countries contributed to the discussion with interesting details about changes in their respective educational systems. John Tanner, Director of Innovative Measurement for the CCSSO, gave a thought-provoking presentation on new ways to think about assessment – including problem-solving and learning skills as well as content knowledge – that was cited often throughout discussions.

New Zealand

The delegate from New Zealand explained that New Zealand has eliminated its national assessment test and made the Ministry of Education responsible for developing additional or supplemental assessments. A special emphasis on improving service to minority students has led to the creation of an online learning portal,⁸ which includes a mathematics glossary translated for Maori students. The outcome has been improved student achievement and fewer disparities between high- and low-performing students.

Malaysia

The Malaysian delegate prompted a thoughtful conversation about the contrast between the reality of education systems and the idealized versions aspired to by governments. Malaysia mandates primary school only and offers a variety of public and private school choices at the secondary level. The Ministry of Education is reviewing the best practices of other countries to determine which applications could be a fit.

Canada

Canada has undergone a major educational reform effort since 2003–2004 with an emphasis on dropout prevention, closing achievement gaps, and reading and mathematics achievement. Canada has undertaken a comprehensive revision of the mathematics curriculum, in recognition of the fact that too much content had been assigned with too little instructional time, and schools are now teaching fewer topics in a more in-depth fashion. Students in Canada are showing improvement as a result of these efforts.

South Africa

In South Africa, a concerted effort to improve participation at the primary and secondary levels has led to a 99 percent participation rate in primary schools and an 86 percent participation rate in secondary schools, and efforts are now turning toward improving the pass rates for students in science and math examinations, with mentors for newer teachers and professional development focused on content knowledge for science and mathematics teachers.

England

In England, a strategic plan brought together different aspects of government into a collaborative role, particularly around science and math education reform, where there has been a targeted effort to infuse the teaching ranks with highly qualified, experienced professionals from outside a traditional teaching background⁹ and curricula have been overhauled to make them more relevant and engaging. Teachers in science and math training are compensated at the highest level, and the Department of Children, Schools, and Families is committed to improving the public estimation of teachers. The strategic plan places great emphasis on 21st century skills, particularly at the secondary level. Student achievement in science and mathematics has risen as a result of these changes.

⁸ Te Kete Ipurangi Online; <http://www.tki.org.nz/e/tki>

⁹ The Children's Plan: Building Brighter Futures; published December 2007, http://www.dcsf.gov.uk/publications/childrensplan/downloads/The_Childrens_Plan.pdf

Lessons Learned and Best Practices

Clearly, a major factor in the success of Singaporean students is the monetary investment in their education by their leaders and policymakers. Other key factors include:

- Comprehensive vision and planning
- System alignment across stakeholder groups
- Long-term adherence to a well-developed strategy
- Integration of content and higher-order thinking skills
- Investment in teachers
- Energy and commitment
- Time and resources

Systemic Alignment through Strategic Planning

In the education system in Singapore, all crucial aspects of the system – teaching, leadership, curriculum/instruction, testing – are aligned in a comprehensive vision and system that functions with a high rate of success. Within the MOE and among the educators of Singapore, the vision is readily available and often quoted.

The education system in Singapore is interwoven throughout Singaporean life because of innovative strategic planning. Singapore created a system based on the individual and his or her contribution to the country as a whole. Education is not divorced from the rest of society.

Singaporean policy leaders are not stymied by having to make choices among different sectors and are thus able to effect wide-ranging structural reform. Active, continuous planning allows them to look at every piece of the system as part of the whole, not in isolation.

Singapore, and other countries like England and Canada, first asked what every student needed to be successful, then considered every aspect, and finally constructed a well-supported plan. Nothing was left to chance.

An emerging theory proposes that the countries that are examining their root structure and system are the ones whose students are making progress. The process is adaptable and constantly improving. As the representative from California noted, “Singapore has created a continuous learning environment that constantly recreates itself within the learning environment.”

Investment in Teachers

As is common in most parts of Asia, in Singapore teaching is an honored profession that is viewed with respect and gratitude. From the beginning, the Singaporean leadership built on this inherent societal attitude and made a crucial investment in obtaining, commissioning, and retaining superior educators. As businessman Lee Iacocca once stated, “In a completely rational society, the best of us would be teachers and the rest of us would have to settle for something else.” This is evident in all aspects of Singaporean culture.

“There is a huge contrast between West and East with regard to teaching. The West is fighting to get quality people into teaching, in the East quality people are fighting to get into teaching.”

—Chris Waterman, England

The Ministry of Education recruits prospective teachers from the top third of graduating secondary school classes and requires a testing and screening progression. Once accepted, applicants enter pre-service education at the National Institute of Education. Prospective teachers are compensated at 60 percent of starting salary while they are students at the NIE.

They then complete a series of courses and degrees in one of 12 specialties. The length of time varies depending on the chosen area and desired teaching level. After receiving their degrees, candidates engage in in-service education and return for training at regular intervals until retirement.

Teachers each receive an annual allotment of 100 hours for professional development, of which 30 hours are reserved for any topic of interest and have no content or course requirement. In addition, they participate in “white space” time each week (“white space” is a term used to describe collective planning time). The amount of time can vary – at Crescent Girls’ School two hours was allotted. Teachers use this time to collectively solve problems and learn from others. These internal and external professional development mechanisms consistently ensure that teachers are updated on national curriculum changes and engaged in reflective learning around practice with other educators.

Teachers can apply for fellowships with the NIE at any point in their career. Self-initiated discovery, knowledge enrichment, and critical thinking mirror the skills emphasis in student learning and form an important part of the MOE agenda for continuous learning, which is also exhibited by its ongoing commitment to research. An assistant professor at the NIE noted, “We give our teachers essentially whatever they need to be successful.”

Investment in Leadership

Singaporean teachers enjoy outstanding support from administrators, at both the local level and the national level. School leadership in Singapore is competitive, highly regarded, and an important facet of the system. Teachers are consistently reviewed for their leadership potential, and those identified as exceptional are moved to the school’s middle management team, which makes collective decisions on strategy and directives. Once there, they undergo intensive training for their new role.

Similarly, middle management team members are rated annually to identify those who show potential for further leadership. A teacher on the middle management team who shows assistant principal qualities undergoes a series of interviews for assistant principalship. If selected, more training ensues. The same process occurs for principals, who are selected from the assistant principal pool. Professional development continues throughout the system regardless of status – the educators of Singapore are constantly upgrading and improving the art and craft of teaching.

It is clear that one of the largest contributing factors to the success of Singaporean students is the nation’s commitment to exceptional educators, who are motivated, supported, and respected by the system. Leadership that supports quality teaching is a critical factor. The delegation found the NIE staff to be deeply committed to helping future educators impact the lives of Singaporean children. Teaching in Singapore is about establishing and consistently developing a love of learning and is modeled systemically at every level.

“At the end of the day, it is about teacher quality. We need to get the best minds we can into the classroom...there are teachable moments everywhere, and Singapore teachers are utilizing them.”

—Dr. Rick Melmer, South Dakota, United States

Curriculum

Innovative core curricular content is a key pillar of the Singaporean system.

The curriculum contains core content and is research and skill based. The MOE reevaluates the curricula every three years to stay current and identify systemic improvements. Researchers scan the globe for best practices and work to integrate proven applications or better information into the curriculum.

The curriculum covers literacy, numeracy, bilingualism, the sciences, humanities, aesthetics, physical education, civics and moral education, and national education, of which the Community Involvement Program forms a crucial part. Creativity and independent thinking are strongly encouraged as part of the effort to foster leadership skills and innovation. Talent and passion are fostered in niche areas such as sports, music, and the performing arts. The bilingual policy requires each child to learn English in addition to his or her mother tongue.

Computer-based programs and multimedia tools are used to engage students, promote independent learning, enhance higher-order thinking skills, build media literacy, and prepare students for our digital world.

Two clear goals are lifelong learning and “teaching less, learning more.” Lifelong learning adheres to fundamentals so that the student can expand beyond the classroom and provides learning opportunities at all ages and in numerous contexts – at work, at home, at school, and through leisure activities.

The “Teach Less, Learn More” (TLLM) philosophy focuses on why, what, and how everything is taught.¹⁰ In moving toward greater flexibility in the classroom, the MOE aims to help students develop the capacity for independent thinking. The goal is to relieve the pressure on students of learning facts that do not connect with other content and prepare them for the global workplace with higher-order thinking skills. (Many delegates considered what “less” consisted of and what the TLLM theory would look like if applied in their respective countries.)

“Creativity in the classroom is critical and should be natural – particularly in science. Students and teachers need to accept existing knowledge but use creativity to create new knowledge based upon scientific learning.”

—Dr. Jongwong Park, Korea

¹⁰ Teach Less, Learn More; Ministry of Education, <http://www3.moe.edu.sg/bluesky/tllm.htm#tllm1>



Recommendations

Review Your Education System and Examine Your Structure

The Singapore Ministry of Education was only one of many players in the evolution of the country's successful education system. Investing in students was seen as a task for every sector of government, and other ministries became involved in a widespread effort. The nations whose students are most successful in science and mathematics achievement regularly examine and assess their education system as a whole.

- Develop a clear vision that every level of every agency within your education system can understand. The goal is to align goals and expectations from the school to the state, so that those who carry out the functional requirements are working in a coordinated effort toward the same goal. Communicate the vision effectively and extensively.
- Develop a firm policy agreement with non-education government agencies within your state or country, in order to cross-reference your agenda and report on student progress to a wide audience. Outside reference points provide for overall goal alignment and facilitate different kinds of support, ideas, and collaboration. The agreement should include entities involved in children's well-being (social services) and those that benefit from successful education programs (economic and business leaders). Regular communication is essential.
- Go beyond the K–12 structure. Provide early support and learning opportunities for students before kindergarten to engage them and further their possibilities for success. Use a data system to build new courses of action after high school graduation. Track student success in the workforce and higher education to gain insight into what is working in K–12. Provide structures and programs to facilitate the transition.
- Build a representative team for regular, collective, structural review, tasked with creating cohesive change throughout the system, implementing research-based best practices, and reviewing existing programs.
- Strive for a coherent system that addresses the key areas for improvement. Design multiple opportunities for success and a full range of pathways to ensure that all students leave school ready to prosper in higher education and the workforce. Assess students frequently so they are on a path that best suits their individual learning styles and ensures they are continually engaged.

Invest in Quality Educators

Teachers are one of the main pillars of a stable society. They help develop the next generation, and, along with parents, are a major source of knowledge and values for children.

- Raise the standing of teachers in society. Teaching must be respected by leaders and by society as a whole. Countries that have acknowledged this – notably, Japan, China, Finland, and Singapore – have flourished in the past decade. Better compensation, resources, support, and instruction for educators are investments that pay invaluable dividends.
- Develop a unified and controlled process for hiring prospective teachers within your largest agency. This requires partnerships between many facets of education.
 - Start by soliciting the best and the brightest students in their junior or senior levels of secondary school. Attract them to the profession through higher salaries, better resources, fully funded higher education, and incentives. Require scholarship and application processes to raise the quality of the profession.

- Partner with a higher education teachers' college to develop it into an outstanding teacher preparation and training institution. Its responsibilities should include inspiring and educating new teachers, ensuring certification, transitioning graduates into learning- and experience-intensive schools supported by mentors, and providing career-long professional development.
- Partner with existing professional development programs (community, business, and the like) to ensure cohesion and effectiveness.

Review Your Curriculum

Memorization of constantly changing factual knowledge, instead of analysis and application, has frequently led to a disconnect between what is taught in the classroom and what students need in the real world.

Some of the most innovative countries around the world are reexamining their curricular content, building consistent content expectations as well as equipping teachers to deliver inquiry-based learning. Depth versus breadth is an important core strategy of their work. As new definitions of literacy emerge, higher-level thinking and complex understanding are being integrated within the content areas. Real-world problems and connections to their own lives make learning engaging and memorable for students.

- Establish or update mechanisms to regularly review and streamline your curriculum. Determine how best to support skill development. Include standards and assessments for the best possible outcome. Identify the leaders or agencies responsible for ensuring that standards and curriculum include world-class practices. Enforce your commitment to strategic goals.
- Establish progressive benchmarking of your current curriculum. Benchmark the rigor and standards of the curriculum with other departments outside education, such as arts and science and engineering. Use the expertise of subject matter specialists and leading researchers in a variety of content fields to validate your work and continually look forward to changing needs and skills.
- Regularly review other cutting-edge curricula from around the world and around your country. Learn from others. Employ researchers to search for the best and most current data. Incorporate new ideas that are contributing to student success and evaluate findings brought in by researchers.
- Incorporate technology to facilitate your curriculum, develop your skills, engage students, and promote their information and media literacy.

Conclusion

The need to move science and mathematics education forward is recognized around the globe. We hope that our recommendations, although far from a finite list, will be a step in the right direction toward promoting higher student achievement in science and math and communicating global best practices for the overall advancement of education.

The Singapore meeting taught our diverse group that looking beyond our own societies for innovation and ideas is extremely worthwhile and humbling. We hope to have the opportunity to apply what we have learned about systematic investment in student improvement and teacher training, better resources, better skills and less content, and a comprehensive commitment to student success. We look forward to continuing to share experiences and best practices in the future to improve learning for all students.

Participants

Mr. Ruy César Pietropaolo, Brazil
Dr. Avis Glaze, Canada
Dr. Frederick I. Renihan, Canada
Mr. Peter Slade, England
Mr. Peter Walsh, England
Mr. Chris Waterman, England
Dr. Leung Hing Keung, Hong Kong
Dr. Mario Dutto, Italy
Mr. Tsuyoshi Enomoto, Japan
Dr. Jongwong Park, Korea
Dr. Azlin Norhaini Mansor, Malaysia
Dr. Zaharian Zainuddin, Malaysia
Mr. Malcolm Hyland, New Zealand
Ms. Anne Jackson, New Zealand
Dr. Penny Vinjevold, South Africa
Dr. John Volmink, South Africa
Dr. Chiaju Liu, Taiwan
Ms. Kathy Cox, United States
Dr. Rick Melmer, United States
Mr. Steve Paine, United States
Mr. Gavin Payne, United States
Mr. Mike Cohen, Achieve, United States
Ms. Bevin Kennedy, CCSSO, United States
Ms. Jennifer Manise, CCSSO, United States
Mr. Scott Montgomery, CCSSO, United States
Mr. John Tanner, CCSSO, United States
Mr. Gene Wilhoit, CCSSO, United States
Mr. Keith R. Krueger, CoSN, United States
Dr. Aik Ling Tan, National Institute of Education, Singapore
Dr. Eng Guan Tay, National Institute of Education, Singapore
Mr. Guy Gerlach, Pearson, Brazil
Ms. June Oei, Pearson, South Asia
Mr. Steve Dowling, Pearson, United Kingdom
Ms. Kathy Hurley, Pearson, United States
Mr. Gary Mainor, Pearson, United States
Mr. Alan Morgan, Pearson, United States
Mr. David Samuelson, Pearson, United States
Mr. Wai Man Wong, Pearson/Longman, Hong Kong
Mr. Che Wah Luk, Pearson/Longman, Hong Kong
Mr. Brett Spodak, Teachers-Teachers.com, United States

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