

*The Future of Mathematics and Science
Education in the Public Schools of Ohio:
Scenarios and Strategies*

A Leadership Paper from the
Ohio Mathematics and Science Coalition



February 2008

The Future of Mathematics and Science Education in the Public Schools of Ohio: Scenarios and Strategies

Executive Summary

About This Leadership Paper

- This leadership paper presents four possible future scenarios for Ohio. The members of the Ohio Mathematics and Science Coalition (OMSC) have identified two critical factors that can shape the future of our state. Those factors are increased access to high quality mathematics and science education for all students and increased development of a globally competitive workforce. The scenarios were designed to create visions of our state in 2025 so that Ohio's citizens might see the impact of decisions made today that affect those two factors.
- The paper provides comparative data that identifies the challenge and need to close achievement gaps and increase educational attainment of groups that have been historically underrepresented within the mathematical and natural sciences in order to tap the competitive potential within all students.
- To reshape Ohio's economy, the Ohio Mathematics and Science Coalition describes several critical steps that must be taken to form school, community, and business partnerships that can move our education system toward higher achievement and competitiveness.

Principal Goals for State Level Advocacy Efforts

- The Ohio Mathematics and Science Coalition will develop a sustained statewide public awareness campaign, targeted specifically at elementary and middle school students that will inform them, their families, educators and policy makers of the career and life-long implications of doing well, or poorly, in studies of mathematics and science. The varied messages will establish clear connections between the needs of the 21st century workforce and increased preparation in scientific and technical skills and thinking.
- OMSC will continue to work within Ohio as a connecting organization to facilitate critical conversations and actions that align measurable results from the mathematics and science education community with the workforce and economic needs of the business and policy communities.
- Working with other groups within the state, OMSC will develop reports and communication materials that mark the progress being made in improving teacher quality, improving the mathematics and science achievement of all students, improving access to quality mathematics and science education programs at K-12 and college levels, and developing the state's competitive workforce and economic base.
- OMSC will also develop further collaboration and shared planning within the Ohio leadership network so that improvement efforts are aligned and can be leveraged to attract additional financial and people resources that increase the global competitiveness of our schools and businesses.

The Challenge

There is increasing awareness that the quality of public education impacts the economic and competitive growth of every state. Ohio's students are competing against students from other states and countries for the knowledge and innovation jobs of the 21st century. The choices Ohioans make about the mathematics and science education of all students will have long-term impacts on the quality of life and citizenship within our state, as well as to extensive economic benefits or shortcomings.

Copyright 2008 by
THE OHIO MATHEMATICS AND SCIENCE COALITION
1375 EUCLID AVENUE
CLEVELAND, OHIO 44115

The Future of Mathematics and Science Education in the Public Schools of Ohio: Scenarios and Strategies

A Leadership Paper from the
Ohio Mathematics and Science Coalition

February 2008

Abstract

The Executive Board of the Ohio Mathematics and Science Coalition (OMSC) adopted the methods of futuring to generate alternative scenarios of public education in Ohio from 2007 to the year 2025. Four scenarios were structured around the two most important and uncertain issues for the future: global competitiveness (and associated strong growth) of the Ohio economy and the access to high quality mathematics and science education in public schools across the state. These scenarios were called 1) "Ohio 2025: The Better Place to Be," 2) "Ohio 2025: We Like It Just the Way It Is," 3) "Ohio 2025: Welcome to Our Third World State," and 4) "Ohio 2025: A Place for the Best, But Not for the Rest." The scenarios exercise provided an external and long-term perspective that led directly to visioning, which is the drawing of implications and potential strategies of OMSC to achieve its mission relative to the potential scenarios of the future. To date, the OMSC has identified four principal, high-impact strategies to pursue: launch a new awareness campaign aimed directly to students themselves about the life-long importance of a high quality mathematics and science education; organize and host conferences of different educators, policy-makers, and leaders across the state to exchange ideas on how to better integrate mathematics and science curricula across the P-16 spectrum of the educational system; produce a new publication on the state of and prospects for mathematics and science education in Ohio; build an aligned, sustainable, and systemic network of stakeholders to advance the quality of mathematics and science education in Ohio.

The Challenge

Many organizations are working to determine what an educated person will need to know and be able to do in their future. Educational improvement should be viewed as a holistic and systemic need, of which improvement in the mathematics and science capabilities of all students is regarded as a reasonable expectation. Overall, students in public schools across Ohio are improving their performance in mathematics and science, but large numbers of students continue to struggle with demonstrating sufficient knowledge of these subjects on state tests and on the National Assessment of Education Progress (NAEP).

As indicators, consider the following points:

- The percentage of students passing each section of the Ohio Fourth Grade proficiency and achievement tests in mathematics rose from 63% in school year 2001-2002 to 77% in 2005-2006; but the percentage of passing on the science tests dropped from 64% to 61% over the same time period.
- The percentage of students passing each section of the Ohio Sixth Grade mathematics proficiency and achievement tests rose from 62% in 2001-2002 to 68% in 2005-2006; it also rose in science from 61% to 67% for the same time period. It is true that when the state shifted from proficiency tests to achievement test the scores tended to shift downward, which frequently happens when tests become more difficult and scoring guidelines are revised. Ohio students, in general, are having a difficult time demonstrating high degrees of success, as defined, in large part, by scores on state-administered achievement and graduation tests. This challenge will continue as rigorous state standards are developed, implemented, and effects measured.
- In the first two years of the Ohio Achievement Tests in 2006 and 2007, the percentage of students scoring on the mathematics tests in the proficient range or above was 76.9 and 75.9, respectively. Furthermore, in school year 2006-2007, according to preliminary results, students improved their scores on Fifth Grade and Eighth Grade mathematics achievement tests, but barely reached the state's goal of 75% scoring at the proficient level.
- In science, the percentage of students in fourth grade passing the Ohio Fourth Grade Proficiency test at proficient or above rose from 54.3% in 2001 to 61.2% in 2005. When the Ohio Achievement Test was introduced in 2007, science was tested at the fifth and eighth grades. The percentage of students passing at or above the proficient level in fifth grade is 68.0%, in eighth grade, 62.7%, well below the state's goal of 75% scoring at the proficient level. (1)

Although passing rates are encouraging and likely reflect improvements in the quality of learning in Ohio's public schools, they might also reflect that the state's public school system is adequately serving only about three-quarters of all students in mathematics. Similarly, these data might reflect that only around two-thirds of Ohio students are being adequately served in science.

Furthermore, an achievement gap remains among demographics. In 2007, a majority of black students did not pass the mathematics achievement tests in Fourth, Fifth, Sixth, Seventh, and Eighth Grades, while a majority of Asian and white students did. Less than one-third of black students and less than one-half of Hispanic students passed the newly-introduced science achievement tests in Fifth and Eighth Grades while a majority of white students did pass.(2)

According to a 2007 evaluation by Achieve, Inc., in cooperation with McKinsey & Company, Ohio student performance in mathematics and science (as well as other subjects) compare favorably on NAEP test scores with that of students in other states. In fact, Ohio students perform above the national average for both Fourth and Eighth Grade levels. However, when compared to criteria that define the NAEP "proficient" category,

less than 40% of Ohio's students meet that distinction. As such, more than 20% of our students who demonstrate acceptable performance as defined by Ohio's measures are demonstrating less-than-proficient performance as defined by NAEP national measures, regardless of demographic factors and socio-economic status. In addition, while Ohio recently ranked 10th among all states in a ranking of state school systems by Education Week, Ohio does not enjoy a particularly high status when compared with the mathematics and science achievements by students in many other countries of the world, including some countries that compete directly with Ohio in global markets. Considering numerous international benchmarks for public education, "...a look at Ohio's performance relative to the U.S. – and the U.S. performance relative to the world – suggests that Ohio's student still have a large gap to close with the best in the world."(3)

These differences are seen as critical when one considers that Ohio students will compete with students from other states and other countries for the jobs of the 21st century. Communicating to the public where Ohio stands on national and international comparisons, and the steps being taken to improve all of our students' vital skills, will continue to be of critical importance to the Ohio mathematics and science educational system.

A challenge for the State of Ohio, then, is to improve the achievement of all students, and to support increased student success and pursuits within mathematics and science, as measured by test scores and other appropriate metrics, through more effective teaching and learning in the public schools of Ohio. While many students are receiving first-rate elementary and secondary educations in outstanding public schools, there still exists a marked degree of inconsistency in the quality of public schools that students attend across the state. As noted by the American Mathematical Association of Two-Year Colleges, 57% of those entering two-year colleges require some remedial work in mathematics before beginning their degree studies.(4) In addition, according to the Ohio Board of Regents, nearly 40% of Ohio students who had completed a core high school curriculum required remediation upon entrance to university course work.(5) These facts highlight a disconnect between the level of preparation attained by many high school students and their ability to meet the academic expectations of Ohio's post-secondary education institutions.

Furthermore, there is an increasing awareness that the quality of public education impacts the economic growth and competitiveness of Ohio, and vice versa. The quality of public education has long-term impacts on the quality of life and citizenship in Ohio in addition to the extensive economic effects.

The goal is to provide a sound foundation in mathematics and science to *all* students regardless of geography, demographics, and economics by improving Ohio's mathematics and science education system. The question is how the state and local school districts, along with the advocacy of the Ohio Mathematics and Science Coalition (OMSC) and other concerned citizens, can directly impact improvements in the quality of mathematics and science education of our public schools in the future.

To begin to address this question, the Executive Board of the OMSC developed this white paper to define and communicate to its members the coalition's strategic plan and advocacy actions for the next five years. A secondary purpose is that this paper can provide information to engage communities, education groups, business forums, and policy officials in considering what Ohio may become over the next two decades depending on the actions that are, or aren't, taken to strengthen our education system and economy.

The scenarios presented in this paper reflect research on state, national, and international trends that will likely contribute to the future of Ohio. The scenarios were generated primarily by the board, but they were vetted among coalition members for initial input and constructive comments. Each of the four scenarios is, with varying degrees, a possible future for Ohio. OMSC believes that where our state goes will depend in large part on the dreams, conversations, plans, and actions that our leaders and citizens develop through regional and state efforts to redefine Ohio through an improved science and mathematics education system. At the federal level, much emphasis has been placed on developing our country's science, technology, engineering and mathematics (STEM) capacity. OMSC believes that a strong mathematics and science education system for all students provides a solid foundation for the innovations in technology, engineering, medicine, finance, and the many other careers that will develop and change in a 21st-century global economy.

Scenarios

The OMSC Executive Board, as a leadership subgroup of the coalition, decided in the autumn of 2006 to begin its new strategic planning process with an external and forward-looking approach for providing context for its future strategies and investments. This orientation is called *futuring*. Among possible *futuring* methods, scenario planning (as developed by Shell Oil Company and other corporations) provides a way to think systematically about long-term alternative futures that are plausible, different from one another, and internally consistent, based on the knowledge of trends, relationships among trends, reasonable expectations, and disciplined imagination. In a series of meetings, the coalition group stepped back from its current programs and culture to consider first how Ohio public education could change over the next two decades. Activities conducted at several state Coalition meetings provided opportunities for members to reflect and give input on this topic. This approach expanded OMSC's strategic thinking (*visioning*) and provided a challenge-based method for developing robust strategies to meet the many potential opportunities of the future. (6)

The OMSC Executive Board began the scenario process by crafting a topic question and identifying the most important and the most uncertain trends, issues, and factors. The topic question read "By 2025, what will be the plausible alternative scenarios for public education (in general) and mathematics and science education, (in particular) as Ohio responds to global trends?" The coalition members generated a comprehensive list of trends, issues and factors that appeared to be highly relevant to the topic question. The

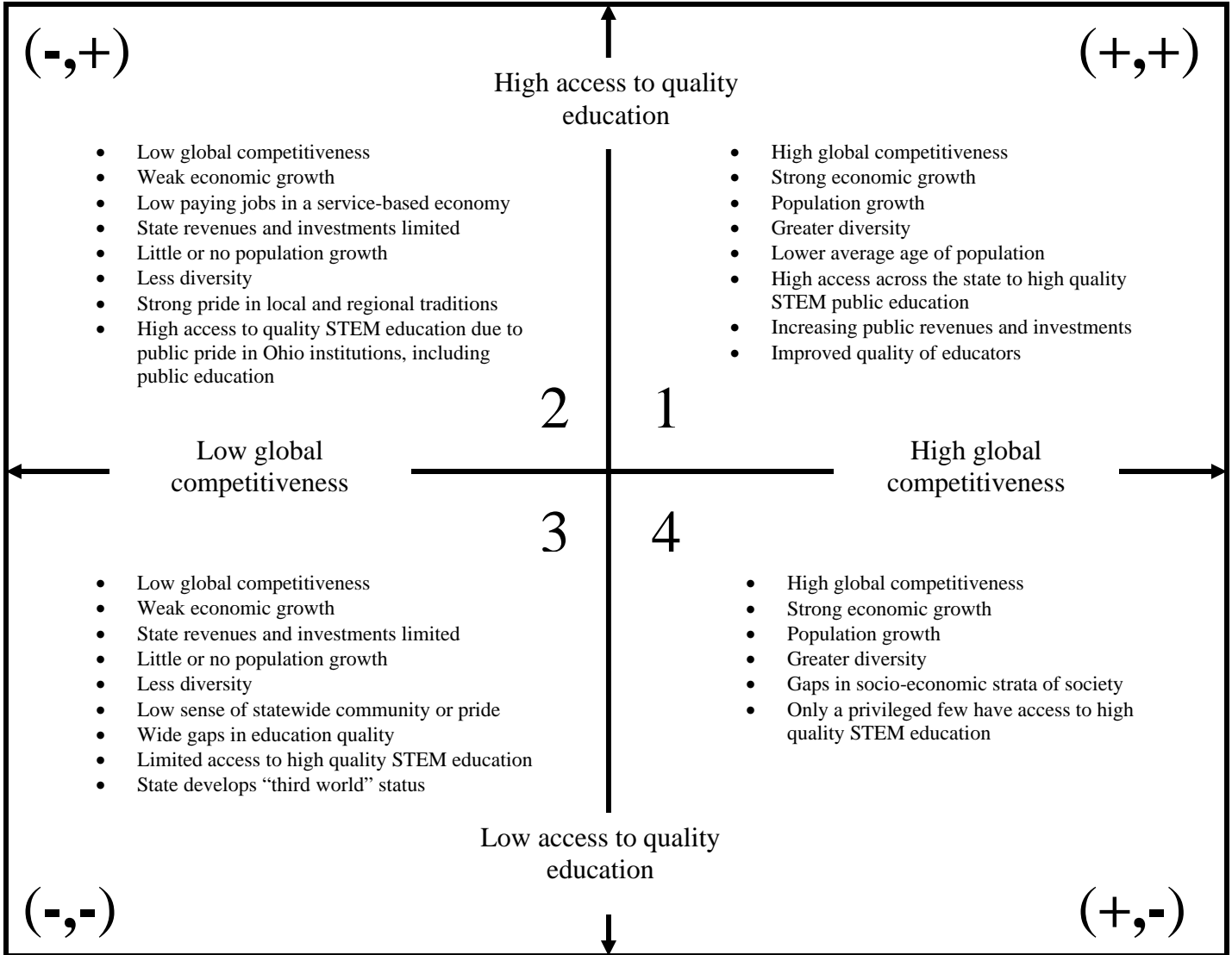
two issues that were judged to be both the most important and the most uncertain provided the structure for generating four alternative scenarios of the future.

After considerable research and reflection on the coalition members contributions, the OMSC Executive Board selected “access to high quality education” and “global competitiveness of the Ohio workforce and economy” as the two most important and most uncertain issues relative to the topic question. “Access to high quality education” means that most if not all students would have access to high quality mathematics and science courses and instruction (and, more abstractly, to high quality public education in general) across the state regardless of geography, demographics, and family economic circumstances. Feedback from coalition members confirmed a consensus of thought that in Ohio today some students have such access, while others do not. Due to a number of factors that exist within Ohio, the quality of mathematics and science education across the state varies greatly in 2007.

The global competitiveness of the Ohio workforce and economy, or more simply “global competitiveness,” means the capability of Ohio to attract, retain, and nurture companies and enterprises that can successfully operate and compete at a global level through high value-added and highly productive labor and management, technologies, plants and facilities, innovative products and services, and processes. Global competitiveness is closely associated with strong economic growth, which in turn is associated with rising standards of living and improved (both quantitatively and qualitatively) quality of life issues. Coalition members again reached consensus that these quality of life issues are linked to Ohio’s long-term economic competitiveness.

“Access to High Quality Education” became the vertical axis and “Global Competitiveness” became the horizontal axis of a four quadrant matrix. Each quadrant became the basis of a scenario that would describe plausible alternative outcomes in Ohio by 2025, using the expert judgments of the participants based on their research, experience, and knowledge of the trends. The four scenarios, provided as descriptions of future conditions as they are likely to exist then, appear on the following pages.

Scenarios for Public Education in Ohio 2025



The Scenarios

	+,+

Scenario 1. “Ohio 2025: The Better Place to Be”

(+, +), or high access to quality education and high global competitiveness.

By the year 2025, as access to high quality public and STEM education became more widely available to students across the state, Ohio high school graduates emerge well prepared for post-secondary education and employment. This outcome results from both public and private investments beyond taxes in public education, the cooperation of public schools with the business community and the institutions of post-secondary education, public support for education as a means to a better quality of life in the future, and state policies that encourage and attract businesses to locate and remain in Ohio.

A new sense of economic and social vigor and well-being occurs in Ohio, as opposed to the dull years at the turn of the 21st century. Employment rates, wages, and household incomes exceed national averages. Foreign companies locate new factories in Ohio – factories that provide state-of-the-art technologies and high productivity. Workers and managers with a range of desirable skills are highly-recruited and well-paid. New enterprises arise in Ohio, which becomes a magnet for venture capital and entrepreneurs. As corporate and private income rises, the tax base for state and local governments also rises, providing funding for infrastructure that in turn attracts more businesses to operate in Ohio. The state also finds ways to create additional sources of public revenues without significantly raising income and property tax rates, resulting in more public investments in the technological infrastructure and public education.

Ohio emerges as a model of what a globally competitive state-level economy should look like. Ohio’s businesses both outsource to other states and countries and are outsourced to by others, due in part to the robust and versatile statewide digital technology infrastructure. Ohio enterprises partner with others worldwide and fully participate in the new global economy. Ohio is viewed as a winner rather than a loser in the new global technological and economic environment.

The population of Ohio becomes more diverse, because companies bring some of their nationals to Ohio and because Ohio’s growing economy attracts energetic people from around the world. Hispanic, Asian, and African populations grow rapidly due to immigration into Ohio. These immigrants are accepted and absorbed into a society that enjoys increasing economic prosperity, security, and a strengthening sense of statewide community. The growth in immigration, many of whom will be under the age of 30 and have young children, lowers the average age of Ohio’s population. Many of these first generation Ohioans value education for their children so that they might enjoy better lives here in the future. The public schools, in turn, are prepared to absorb growing numbers of students with diverse backgrounds and different needs but with similar expectations for educational excellence.

With improved public education and growing job opportunities, young people tend to stay in Ohio. Young people from other states and countries are also drawn here. The increased productivity of Ohio workers occurs due to technology investments and the

advanced skills of employees, both labor and management. New enterprises spring up in Ohio, generating a new level of creativity in products and services. Out-of-state and foreign businesses are attracted to Ohio for many reasons, the most important of which are the advanced skills of people, their ability to learn and adapt, increasing innovation, intellectual properties (IP), and the quality of life in Ohio. The state's political, economic, and social environment becomes more business-friendly and the state experiences higher economic growth.

As economic conditions improve, people become generally less fearful for their own well-being and more concerned about the plight of the less advantaged people of society. A sense of a state community emerges. Traditional localism gradually breaks down, being replaced with a stronger identity in being a Buckeye. This pride extends to state leadership in education with local district cooperation. More funds flow from the state government to the districts that require supplemental resources to achieve state education standards.

There is a close tie between economic growth, based largely on competitiveness in the new global economy, and the quality of public education, especially in mathematics and science. While Ohio industries and enterprises shift from Rust Belt mills and factories to highly modernized, technological, and productive facilities, STEM knowledge and skills become increasingly valued. The state invests in a comprehensive infrastructure in information and communications technologies (ICT). In addition, Ohio emerges as a new energy state based on advanced technologies in alternative energy sources, such as fuel cells, and carbon dioxide management.

Public schools make major commitments to the quality of mathematics and science education because students and society demand them. State standards are raised, and student achievement test scores also increase due to better curricula and instruction. The professional qualities of mathematics and science teachers improve over time due to better preparation in colleges and continuous professional development. Teacher salaries increase, reflecting both improved educational productivity and a new respect for the teaching profession. Inconsistencies in the quality of public education across the state fade with time, permitting a more general access to high quality mathematics and science education for all students regardless of geography, demographics, or household incomes.

The value of STEM education in particular becomes evident as young adults in the institutions of post-secondary education, in many kinds of jobs, and in their careers need to apply quantitative problem-solving skills, sound judgment, the fundamental principles of physics and chemistry, statistics, and money-management skills.

As high-quality education in Ohio becomes more equal and accessible to all, with the resulting increase in the availability of high quality, high paying jobs, education becomes more highly valued by most Ohio residents. With the level of educational achievement of the population increasing, the public awareness of the importance of education rises. As the population in general sees further achievements in the schools, they are more

willing to invest in them as opposed to funding unsuccessful schools, or “throwing good money after bad.”

As the public begins to demand better results from the public education system, the expectations for teacher quality also rises. Teaching achieves a new plateau of professionalism based on improved preparation, team teaching, and continuous professional development of teachers.

Universities collaborate more closely with industries to address major research and development (R&D) challenges in both basic and applied research. R&D, including open and exploratory projects among professors and students, pursues long-term, strategic opportunities beyond short-term profit to achieve sustainable productivity and competitiveness on a global plane. In addition, both universities and industries work more closely with high schools to improve instruction and provide learning opportunities that will become the practical foundation for future employment and careers.

This scenario could occur if the rate of economic growth were to increase in Ohio because of both public and private investments in new technologies, new productive facilities, an ICT infrastructure, and new enterprises. It could occur if the population of Ohio were to grow larger and younger due to increased immigration; if there were increased cooperation and collaboration among public schools, businesses, and the institutions of post-secondary education; the state standards and achievement test scores were to continue to rise, reflecting substantive improvements in the quality of public education; and if the state and local school districts were to invest more into public education, especially in mathematics and science. This scenario is predicated upon further evidence that high quality mathematics and science education does indeed produce the skilled workers and managers, technologies, and innovations that directly leverage stronger economic growth and global competitiveness; and that stronger economic growth will provide the resources and incentives for the continuously improved quality of mathematics and science education throughout Ohio.

-,+	

Scenario 2. “Ohio 2025: We Like It Just the Way It Is”

(-, +), or low global competitiveness and high access to quality education.

Rather than bemoaning slow economic growth and the deterioration of Rust Belt industries, the people of Ohio generally like the way the state is and they are satisfied with the quality of their lives by the year 2025. They take great pride in their traditional ways of life and their institutions, including their public schools, regardless of economics and the opinions of outsiders. Many people follow their daily routines without paying much attention to national and global trends. They may not like rising gasoline prices, but they are not particularly worried about the future of oil, natural gas, and electricity. They may have heard of global climate change and carbon dioxide management, but they give such concerns little thought. Terrorism is also something that people believe occurs elsewhere, but not in Ohio.

Ohio's economic growth rate may continue to grow, but very slowly. It may even decline into negative growth rates. Ohio's economy continues to fall relative to other states, including such neighbors as Pennsylvania and Indiana. Ohio students receive a fundamentally sound public education, but the career-minded and ambitious ones are likely to migrate to other states, where growth opportunities appear more promising. The average age of Ohio's population increases, reflecting the exodus of young adults from the state. (In the early years of the 21st century, Ohio led the nation in terms of out-migration of young adults.) Because of low job growth and stagnant wages, Ohio attracts fewer immigrants, so that the diversity of Ohio's population declines. The demographics and social values become more homogeneous. Some very sophisticated companies with advanced technologies and skilled employees exist in Ohio, but they are exceptions among many mundane industries with low to medium levels of productivity. There are growing disparities among local economies and standards of living across the state.

Taxes slowly rise in Ohio, which spends increasing amounts of public dollars on health care, education, and infrastructure in response to increasing demands placed upon public services. Rising health care costs, especially for the increasing older population however, strain state budgets and limit growth rates in state spending for education and infrastructure. In turn, with time the infrastructure deterioration places increasing burdens on local governments that may not have adequate resources to address all sorts of local needs. The state makes only marginally effective investments in the ICT infrastructure. Ohio continues to enjoy many social and economic advantages, but it slowly deteriorates relative to other states and countries that are more vigorous participants in the new global economy.

Because of the combined effects of low economic growth, low immigration, and increased out-migration among young people, the average age of Ohioans increases and diversity of the population declines. Traditionalism sets in with strong local and regional sentiments. Ohio becomes increasingly a political unit based on a social fiction of a popular statewide identity. Yet, many people in Ohio express a stubborn pride in their traditions and support high quality in education because Ohio schools are the best simply because they are located in Ohio.

Public education generally continues to improve in quality across the state. The state and Federal governments provide more funding for public education, although funding levels across school districts might vary greatly. Achievement test scores advance, including those in mathematics and science. People take pride in public education because of their sense of pride in Ohio independently of economic conditions. There is access to high quality STEM education in the public schools for those who want it, although many students do not take full advantages of their educational opportunities. While the most ambitious students tend to go out of state for higher education and careers, those who remain in Ohio adopt a sense of self-satisfaction and like Ohio just the way it is.

School funding provides financial incentives for individuals to pursue teaching careers in a variety of subject areas, including STEM. More and better teachers are attracted to mathematics and science. However, despite the acknowledgement of the public about the

importance of STEM education for students, there may be little support in parts of the state from parents and families for requiring advanced mathematics and science courses for graduation. It becomes socially acceptable in some locales not to know much beyond elementary science and mathematics.

This scenario could occur if further improvements were to occur in public education while economic growth remained modest. There is a possibility that the state and local school districts could improve the quality of public education and yet the general economy of Ohio may not perform much better than it is today. People may take pride in education just for the sake of having a good education. Yet, over extended periods of time, Scenario 2 may not be stable, as declining economics will likely lead Ohio toward Scenario 3.

-,-	

Scenario 3. “Ohio 2025: Welcome to Our Third World State”
 (-, -), or low access to quality education and low global competitiveness.

In 2025, Ohio continues to decline in its economic, social, and political standing relative to other states. States like Indiana, North Carolina, Georgia, and Arizona pass Ohio in terms of population, economic growth, and electoral votes. Ohio looks like a very tired Rust Belt state that never recovered from the changes created by the new global economy at the beginning of the 21st century. It will be seen like a Third World state within the U.S. in the sense of a struggling economy with a relatively poor standard of living.

Low expectations for high quality jobs lead many people to accept low expectations in education. What is the use of a good education if there are not good jobs to go to? Why educate our children just to prepare them to leave home? These questions will be frequently heard around the state, especially in inner city and isolated rural areas. Unlike Scenario 2, people in Scenario 3 will generally take little interest or pride in education. More likely, they will be satisfied with just the fundamentals and not value good education just for the sake of having a good education. What’s the point of it?

Funding for public education remains flat, or declines in real terms. State leadership is weak in areas of long-term educational planning and accountability, with most decisions made at the local level. People resist paying higher income taxes and higher property taxes for public education, which is viewed as a low public sector priority. Opportunities for teachers to have satisfying careers are no more promising than those in industries. It is difficult to keep the best teachers within the state, having further negative impacts on the quality of education. Although the state may continuously raise standards, student test scores remain largely flat. Some students seek and receive world-class education, but they are largely concentrated in affluent suburban public and private schools. Most students across the state do not have access to high quality public education, including mathematics and science.

There has been a steady decline in per capita personal income in Ohio relative to the national average since the 1980s and a sharp decline since 1994. In short, Ohio is falling behind general economic growth in the U.S.(7) A primary problem is that too few new companies have too few high quality jobs for too few talented employees in Ohio. Ohio is not able to compete successfully with other states and countries in the new global economy.

In many respects, this scenario is the exact opposite of Scenario 1. Ohio’s economic downward spiral that began in the 1990s continues for several decades. Economic growth appears barely positive and may degrade to negative growth. Few new industries thrive in the state, which cannot find a way to reposition itself from the Rust Belt to the new global economy. One of the few areas of employment growth is the relatively low paying end of the service sector. Talented young people generally migrate out of the state to find more promising jobs and careers. The average age of the state’s population continues to rise, leaving Ohio with one of the oldest populations in the U.S. and with many of the societal care issues that accompany an aging population.

This scenario could occur if present trends were to accelerate and if both economic and educational conditions were to worsen further. In this scenario, in contrast to Scenario 2, both the quality of public education and the performance of the state’s economy will continue to decline because of a very strong mutually reinforcing relationship among the quality of education, global competitiveness, and economic growth. Perhaps the most troubling trends are popular apathy, political stalemate, and business indifference about the future of Ohio.

Scenario 4. “Ohio 2025: A Place for the Best, But Not for the Rest”

(+, -), or low access to high quality education and high global competitiveness.

	+, -

In this scenario, by the year 2025 Ohio enjoys participation in the new global economy and emerges competitively strong through new industries, technologies, and skilled workers and managers. Relatively few Ohioans, however, benefit from rising incomes due to their education, talent, knowledge, and skills. Some students gain access a high quality education that is available to an elite stratum of society but not to many other students around the state.

New factories are built in Ohio, but they are technology, rather than human labor, intensive. The number of factory jobs for unskilled and low-skilled workers declines, as companies hire fewer, but highly-skilled, people to meet employment needs. These employees have more responsibility for making decisions within highly automated plants. Productivity, due to technology and highly skilled employees, rises sharply due to new equipment and sophisticated controls. ICT makes a huge improvement in the quality of both manufacturing and services. Ohio companies compete successfully with rivals around the world. Yet, relatively few Ohioans enjoy rising salaries and household incomes. The ones who do are the ones who receive a high quality education and compete successfully for high paying jobs and professions. Many Ohioans,

unfortunately, do not receive a high quality education and are consequently poorly prepared for post-secondary educations and well paying jobs in the new global economy.

In economic and technological terms, Scenario 4 is very similar to Scenario 1. The critical difference between the two scenarios is that rapid economic growth in Scenario 4 does not drive sufficient investments and improved performance in public education for all students. The state invests in other areas of the public sector, such as public health and safety, rather than in education. State budgets for education may increase, but not enough to cover the growing needs of the schools to educate more and more diverse students. Local school districts have to bear increasing proportions of public school costs; some districts, especially those in affluent suburbs, raise taxes to invest in high quality educational systems, but many districts do not. Inner city schools continue to deteriorate; so, too, do many of the rural schools in the Appalachian region of southern and southeastern Ohio. Where people are not enjoying the benefits of the new global economy, they lack motivation to pursue better education and training. There is an increasing level of inconsistency in educational resources and performance across the state.

Ohio becomes a state with an economy that relies on the best, but not the rest. There are relatively few households that benefit from rapid economic growth and Ohio's new competitiveness in the new global economy. They are largely concentrated in the suburbs and exurbs near large metropolitan areas. They have fine houses, fine cars, and fine schools. They know that they can pass their social status to their children not so much by inheritance as by assuring that their children receive first-rate educations that will earn them high incomes in the future. The socio-economic gap in Ohio widens, as more middle class families struggle to readjust to the needs of the new global economy. The poor may see increases in household incomes, but their increases pale in comparison with those of the top 20% of households. Without sufficient education, the children of the endangered middle and labor classes of society have to struggle for what few well paying jobs and careers await them.

Political leaders and large segments of the population generally fail to realize that strong economic growth is driven, in large part, by high quality education and that high quality education is largely driven by strong economic growth. These mutually reinforcing trends in economic growth and quality education for all Ohioans are generally realized in Scenario 1, but not in Scenario 4.

Schools that produce students with excellent test scores attract highly qualified educators, while schools that foster low levels of success continue to struggle to attract and retain good teachers and leadership to effect positive change. The standards for excellence are inconsistent from school to school, in part because of the wide variations in community expectations for public education. The good schools become better and the poor schools get worse, further spreading the education and aspiration gaps among Ohioans.

This scenario could occur if the economy of the state were to boom, but the boom would benefit only a relatively small number of people. Economic growth might occur, as in

Scenario 1, because of private and public investments, new technologies, new products and services, and highly productive people. In this scenario, however, the economic growth is not leveraged to improve the general quality of public education, and subsequently peoples' quality of life, across the state. There will be many kinds of socio-economic differences among people, which are also likely to generate inequalities in the access to high quality education.

OMSC's Proposed Strategies and Advocacy Actions

Having generated the four scenarios above as objectively as possible, the OMSC group shifted from futuring to visioning, which inserts matters of culture, values, mission, and organization into the strategic thinking process. The group looked at the scenarios and asked which ones held the most appeal, the least appeal, and why. This approach led directly to the identification of OMSC strategies that would be most likely to influence external issues resulting in the most desired outcomes in the future.

The group concluded that Scenario 1, "Ohio 2025: The Better Place to Be" is the most desirable scenario because it represents a future in which the improving quality of public education influences global competitiveness and strong economic growth. Such growth will be the foundation for higher standards of living and improved quality of life for all Ohioans. Scenario 1 also anticipates greater social harmony and equality of educational opportunities for all Ohioans. It is a scenario in which one would expect a growing middle class of employees, managers, and consumers. Conversely, Scenario 3, "Ohio 2025: Welcome to Our Third World State," would be the least desirable scenario because poor economic growth, low global competitiveness, and lower quality public education will likely result in lower paid jobs, industrial and business declines, lower standards of living, and generally a poorer quality of life for most Ohioans. A further consideration of these two scenarios provided insights into what conditions and what associated developments must or must not occur to lead to a desired future.

The members of the OMSC group generally did not find either Scenario 2 or Scenario 4 attractive. They felt that Scenario 2, "Ohio 2025: We Like It Just the Way It Is," reflected misplaced public values and regionalized, even parochial, attitudes. Many concluded that Scenario 2 is probably not stable and could eventually degenerate into Scenario 3.

Likewise, many did not like the social overtones of Scenario 4, "Ohio 2025: A Place for the Best, But Not for the Rest." This scenario suggested social disharmony, and, perhaps, social unrest manifested in gangs, violence, and rampant crime among the most disadvantaged segments of society. One might even compare Scenario 4 with a type of society in which there is a very small strata of society that holds great power and wealth, a limited professional and

middle class, and a large number of poor people struggling to survive on a daily basis. Members of the coalition seemed little interested in advocating for strong mathematics and science educations if such educations became elitist in nature and unavailable to a large majority of students around the state.

In addition, Scenario 4 may not be a sustainable economic environment, and over time companies may leave for locations that have the type of stability demonstrated in quadrant 1. Scenario 4 could be seen as an unstable environment that is likely to move in the direction of Scenario 3 if the economic base and educational opportunities cannot be sustained for large segments of the population.

Following a consideration of the scenarios, both objectively and normatively, the OMSC group engaged in a creativity exercise that produced 40 ideas on what strategies would most likely lead to Scenario 1 and mitigate, if not prevent, the occurrence of Scenarios 2, 3, and 4. Upon further reflection, the group clustered the ideas into the following 10 categories of strategies:

- A. Public awareness – parents, students, communities, and legislators need to know what good mathematics and science educations are and why they are important
- B. Strong educational leadership with a vision across the board, including the instructional leadership of schools by principals
- C. The need for a technology infrastructure for all of Ohio, including wireless, high speed, and broad band ICT
- D. A seamless pre-school through post secondary education (P-16)
- E. Teacher understanding and practical work experiences to teach mathematics and science appropriate to the grade level, including the better preparation of mathematics and science teachers, especially in middle schools and pre-school to Fourth Grade and the continual professional development of teachers
- F. More cohesive communities and regional cooperation for the improvement of schools
- G. Affordable higher education for all who seek it
- H. Closing the gaps in student achievement among various racial, ethnic, and socio-economic categories of students
- I. Elimination of bad effects of testing
- J. Increased investments made by the legislature in R&D for a competitive economy in the institutions of higher education.

From this list of potential strategies, the OMSC group further focused on strategies that best fit the OMSC mission, which is to foster collaboration and facilitate communication among all mathematics and science stakeholders; to facilitate the definition of a continuous improvement plan for P-16 mathematics and science education and to disseminate the plan; to advocate for necessary changes in teacher pre-service training; to advocate for necessary changes in curricula and supporting instructional materials; to

advocate for necessary changes in the manner in which student performance is assessed such that Ohio's citizens will know where its students, schools, and districts stand relative to others in Ohio, the nation, and the world; and to advocate for legislative actions necessary to finance and accomplish the above.

The OMSC Executive Board constructed a table aligning the most important actions shown above with OMSC strategies, OMSC goals, and potential metrics. Four principal goals and strategies were extracted from this exercise:

1. Students and their families need to understand better the life-long implications of doing well, or poorly, in mathematics and science courses and tests. OMSC should conduct a sustained statewide awareness campaign that would place the primary focus on communicating to students themselves with a secondary audience being their families, neighbors, and communities. The goals and metrics of success of such a campaign would be directed toward both short-term and long-term improvements in mathematics and science course grades, achievement test scores, advancement (graduation) rates, and future success in post-secondary education and employment. Another metric would be the shifts in perceptions and attitudes about the importance of STEM education to future success in life.
2. Partnerships for improving education must be established within the state and its communities, as well as establishing a conduit to connect communities together throughout the state in support of an improved mathematics and science education system for all students. OMSC will work as a connecting organization to facilitate the flow of communications, align the business and education network of those working to strengthen Ohio's mathematics and science education system, and promote the sharing of effective curricula, teaching practices and assessment options. OMSC will organize, conduct and facilitate meetings of educators, policy makers, business leaders and other leaders in mathematics and science to align their points of view and to promote a greater degree of seamless collaboration in improving the quality of mathematics and science education from P-16. These summits should be held regionally, to address each region's educational and economic strengths and needs, as well as at the state level with high-ranking leadership.
3. Experts in science and education need to take a forward-looking position on best practices in STEM education. Toward this goal, OMSC will prepare and distribute a follow up to the 2001 OMSC publication *Finding the Solution* (8) that will include indicators of progress and present new research or information that has developed over the past several years. The publication's message will be aimed primarily at families and communities as a component of the two strategies above. Additionally, OMSC will work with other groups to prepare an annual summary report specific to changes in achievement

and attainment of degrees in mathematics and science, as well as teacher preparation in mathematics and science education.

4. Ohio needs a closer knit community of leaders to integrate and improve the quality of STEM education through the entire system. OMSC will bring together, align, and coordinate on a sustainable, systemic basis the efforts of the Ohio Board of Regents (OBOR), Ohio Resource Center (ORC), Ohio Department of Education (ODE), and OMSC. This would also include the Board of Regents' Centers of Excellence and the 16 regional support centers of the Ohio Department of Education. Also included would be groups of leaders from business and government interested in improving the state's mathematics and science education system. This strategy parallels the second strategy above by facilitating communication and aligning improvement efforts of the state's major education agencies in a way that can be communicated with policy-makers and the public.

OMSC will be further refining these strategies in early 2008 with implementation as soon as possible.

What Is Your Role in Ohio's Mathematics and Science Education Improvement Efforts?

Many businesses have undergone a process of redesign and reengineering to adapt to the demands of a rapidly-changing global economic landscape. Some wonder whether the education system has undergone similar changes that would allow its students to be successful in the numerous career paths they may encounter. The members of the Ohio Mathematics and Science Coalition believe that improving the quality of mathematics and science education in Ohio's public schools is everybody's responsibility. In that belief, OMSC encourages all of Ohio's citizens to do the following:

- A. Remember, and remind others, that the mathematics and science education that they access and attain in Ohio connects directly to economic growth, global competitiveness, and enriching the quality of their adult lives. OMSC, through its sustained public awareness efforts, will actively promote this message with Ohio's students as they progress through all levels of their education. Consistent support and distribution of this message in various ways and forms should also come from parents, educational institutions, community and state leadership.
- B. Ask questions of the public school administration and the teachers about what they are teaching in mathematics and science to their students, and about their schools' efforts to improve and ensure quality education in these critical areas, including support systems for all students to help them develop strong skills and deep understanding in these areas. Ask what schools are doing to increase teachers' understanding and use of current research in teaching and learning, as well as how they are developing a deeper understanding of the mathematics and science that are necessary to teach toward a world-class education.
- C. Ohio's citizens are entitled to know how students compare to others within the state, across the nation, and throughout the world. Insist upon the setting of high standards in mathematics and science for all Ohio students, and for clear communication of data to Ohio's citizens about the progress and performance of our schools. Discuss, or communicate in other ways, these expectations with your representatives on local school boards, the State Board of Education, our Governor's office, and the Ohio legislature.
- D. Encourage and engage in new relationships among families, educators, state policy-makers, and other community leadership groups to seek ways that better develop, communicate and integrate sound, challenging, and applicable mathematics and science curricula across the entire P-16 educational system. These

improvements should not be implemented to the exclusion or reduction of other subjects and endeavors, but rather implemented as an integral part of a rich, comprehensive education and career preparation for all students.

- E. Advocate for an improved STEM education, intertwined with parallel educational innovations in languages, arts, humanities, and the social sciences toward the objective of producing well-rounded and versatile adults who will bring many talents and diverse knowledge to the competitiveness of Ohio in the new global economy.

References

1. State Board of Education of Ohio, *Annual Report 2005-2006* (Columbus, OH: Ohio Department of Education, 2006) , p. 24 Also see <http://www.ode.state.oh.us> under “Data and Statistics.”
2. Cindy Kranz, Ben Fischer and Denise Smith Amos, “Ohio test scores up overall,” *Cincinnati Enquirer* as reported in News Clips of the Ohio Department of Education, July 18, 2007, p. 1.
3. Achieve, Inc., *Creating a World-Class Education System in Ohio*,” report for the State Board of Education and the Ohio Department of Education, February 2007; quote on p. 3.
4. American Mathematical Association of Two-Year Colleges, *Beyond Crossroads: Implementing Mathematics Standards in the First Two Years of College*, 2006, p. 4.
5. Ohio Board of Regents, “*Making the Transition from High School to College in Ohio 2003: A Statewide Perspective*”, 2004, pg. 13.
6. Stephen M. Millett, “Futuring and visioning: complementary approaches to strategic decision making,” *Strategy & Leadership*, Vol. 34, No. 3, 2006, pp. 43-50; Stephen M. Millett, “The future of scenarios: challenges and opportunities,” *Strategy & Leadership*, Vol. 31, No. 2, 2003, pp. 16-24; Michael E. Raynor, *The Strategy Paradox* (New York: Currency Doubleday, 2007), pp. 206-272; Bill Ralston and Ian Wilson, *The Scenario Planning Handbook* (Mason, OH: Thomson South-Western, 2006).
7. Ohio statistics can be found under “Research and Data” on the Ohio Department of Development website, www.ode.state.oh.us.
8. Ohio Mathematics and Science Coalition, *Finding the Solution: Bringing Mathematics and Science Education in Ohio into the 21st Century*, 2001

© 2008



Ohio Mathematics & Science Coalition

www.OhioMSC.org

1375 Euclid Avenue
Cleveland, OH 44115