The Florida Senate

Interim Report 2010-112 *October 2009*

Committee on Education Pre-K - 12

REVIEW THE EFFECT OF STATE HIGH SCHOOL GRADUATION REQUIREMENTS ON STUDENT PREPARATION FOR POSTSECONDARY EDUCATION AND THE WORKFORCE

Issue Description

To earn a high school diploma, Florida high school students are required to complete 24 credits: four credits in English; four credits in mathematics, which must include one credit in an Algebra I or higher-level course; three credits in science, two of which must include laboratory components; three credits in social studies; one credit in fine or performing arts, speech and debate, or a practical arts course; one credit in physical education; and eight elective credits, including four credits in a major area of interest. Additionally, students must earn passing scores on the Florida Comprehensive Assessment Test (FCAT) or equivalent.[1]

During the 2009 Legislative Session, a bill was filed to increase the rigor of math and science courses required for high school graduation.[2] The bill did not pass. Concerns were raised as to whether the state had educators certified in mathematics and science in numbers sufficient to cover increased enrollment in more rigorous courses. Concerns were also raised as to whether the state could adequately fund the professional development for teachers necessary to enhance mathematics and science instruction in the classroom. It is anticipated that efforts to raise the high school graduation requirements will be proposed for the 2010 Legislative Session.

Background

Global Competitiveness and STEM-Related Skills (Science, Technology, Engineering, and Mathematics)
The business and education communities have stressed the importance of a talent pool of STEM-skilled students, instructional personnel, and workforce employees, all with the math, science, and literacy skills to effectively compete in a global economy.[3] While the research has not effectively addressed the human and financial capital necessary to generate a sufficient STEM talent pool, the current economic landscape demands that targeted investments be made, not in spite of the economic downturn, but rather because of it. Florida must be poised to attract new business enterprises in order to revitalize and expand the state's economy, and businesses look first to a state's ability to produce a talented workforce.[4]

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[1] Section 1003.428, F.S. This provision applies to students entering their first year of high school in the 2007-2008 school year and thereafter. Students who entered high school before the 2007-2008 school year are required to complete the high school graduation requirements in s. 1003.43, F.S., which for purposes of this report, only required three credits in mathematics.

[2] Committee Substitute for Senate Bill (CS/SB) 2654 (2009)

[3] The American Diploma Project, Achieve, Inc., available at http://www.achieve.org/ADPNetwork. *Innovation America, Building a Science, Technology, Engineering and Math Agenda*, National Governor's Association, available at http://www.nga.org/Files/pdf/0702INNOVATIONStem.pdf. *National New Economy Workplace Study*, Achieve, Inc., available at http://www.achieve.org/node/625. *Strategy Council Ad-Hoc Subcommittee on K-12 STEM Education Discussion Paper*, Enterprise Florida, available at http://www.eflorida.com/uploadedFiles/floridas_future/STEM_Subcommittee_Discussion.pdf. *Preparing the Workers of Today for the Jobs of Tomorrow*, July 2009, Executive Office of the President Council of Economic Advisors, available at http://www.whitehouse.gov/administration/eop/cea/Jobs-of-the-Future/.

[4] *Florida's Economic Drivers, Talent and Education*, The Florida Chamber Foundation, available at http://www.flfoundation.com/talent.asp.

Policy-makers and educators continue to respond to Florida's standing on national test results, including the 2007 Trends in International Mathematics and Science Study (TIMSS), which found U.S. fourth and eighth graders trailing Asian and European peers in science and math. TIMSS demonstrates that our nation continues to lose ground in both of these critical academic domains. The National Governors' Association reports that the United States currently ranks 21st in science literacy and 25th in mathematics among the 30 Organisation for Economic Co-Operation and Development (OECD) countries.[5] Consequently, a majority of research publications[6] conclude that: (1) U.S. students cannot compete in a global economy given the current status of mathematics and science skills taught in public schools; and (2) the mathematics and science skills necessary to succeed in both the workforce and postsecondary institutions are almost identical.[7]

Recent Florida Changes to Math and Science Requirements

In 2006, the mathematics credits required for high school graduation were increased from three credits to four, but without requiring an increase in the level of rigor within the course requirements beyond Algebra I.[8]

While Florida students have continued to make laudable achievement gains in reading and mathematics, the preponderance of gains have been made at the elementary level, with scores tapering off at the middle grades and continuing to fall during the high school years. Lack of achievement in science, however, continues to be of great concern at every grade level, both in Florida and at the national level.[9] Based on FCAT achievement levels from the past three academic years, the chart below reflects the percentage of students in school years 2006-07 through 2008-09 scoring below grade level in mathematics and science. All Florida students in grades 3 through 10 are scored within five performance levels on the FCAT as follows:

Level 5: Successful with the most challenging grade-level content
Level 4: Mostly successful with challenging grade-level content
Level 3: Partly successful with grade-level content – performance is on grade level
Level 2: Limited success with grade-level content
Level 1: Minimal success with grade-level content

Percentage of Students Scoring Below Grade Level 2006-07 through 2008-09

Below Grade Level Math Grade 3	Below Grade Level Math Grade 8	Below Grade Level Math Grade 10
24%	**35%**	**32%**

[5] The OECD is an organization that brings together the governments of countries committed to democracy and the market economy from around the world to support sustainable economic growth, boost employment, raise living standards, maintain financial stability, assist other countries' economic development, and contribute to growth in world trade. OECD's website is available at http://www.oecd.org/.

[6] *Accelerating the Agenda,* The National Governors Association, the National Conference of State Legislatures, the Council of Chief State School Officers, and the National Association of State Boards of Education. *The Economic Impact of the Achievement Gap in America's Schools*, *Benchmarking for Success 2008,* The National Governors Association, the Council of Chief State School Officers, and Achieve, Inc. *Fostering Learning in a Networked World,* The National Science Foundation. *Foundations for Success,* National Mathematics Advisory Panel. *Out of Many, One,* Achieve, Inc. *Building a STEM Agenda,* National Governors Association. *Rigor at Risk,* American College Testing. *Taking Science to School,* National Research Council. *Tough Choices or Tough Times,* National Center on Education and the Economy.

[7] *Math at Work,* Achieve, Inc., available at http://www.achieve.org/mathatwork.

[8] *See* s. 23, ch. 2006-74, L.O.F.

[9] *Taking the Pulse of Bioscience Education in America: A State-by-State Analysis*, Biotechnology Industry Organization, available at http://www.bio.org/local/battelle2009/main.asp.

Below Grade Level Science Grade 3	Below Grade Level Science Grade 8	Below Grade Level Science Grade 10
56%	60%	63%

Equally concerning is the percentage of students in grades eight and ten who read below grade level. Nearly 48 percent of eighth graders and 64 percent of tenth graders cannot read or adequately comprehend grade-level text, significantly reducing these students' chances of experiencing success in mathematics and science.

Essential Components in the Development of a Comprehensive Statewide STEM Initiative

In recognition of the state's need to increase the rigor of math and science courses required for graduation, SB 2654 was filed in the 2009 Legislative Session. This bill would have established incremental increases in required mathematics and science coursework beginning with students entering grade nine in the 2010-2011 school year. A major concern with the proposal was whether the state possessed a sufficient number of high quality teachers to teach the additional coursework. Other concerns were raised with respect to the cost of hiring additional teachers and needed professional development, and the effect of more rigorous course requirements on students struggling to graduate.

Findings and/or Conclusions

The Education Commission of the States (ECS) has taken a leadership role in assessing individual state initiatives aimed at more rigorous high school coursework.[10] In spite of the arguments suggesting that increasing the required rigor of mathematics and science is cost prohibitive and detrimental to academically struggling students, 17 states have committed to more rigorous mathematics and science coursework for their high school students.[11] However, each of these states has increased requirements as part of a comprehensive STEM initiative (Science, Technology, Engineering and Mathematics) in an effort to stimulate lagging state economies.[12] All 17 states include the following four components to build and sustain a successful STEM initiative:

- Adoption of rigorous math and science coursework requirements for their high school students;
- Aggressive recruitment of a talent pool of STEM educators to include early elementary through postsecondary;
- Investment in comprehensive STEM-related professional development for their teacher workforce; and
- Development or acquisition of comprehensive end-of-course assessments aligned to the rigorous math and science requirements.[13]

In tracking national trends in state STEM initiatives, the ECS has attempted to dispel the misconceptions of the negative effects associated with the adoption of more rigorous mathematics and science requirements.[14] Such misapprehensions include the following:

- More rigorous requirements would result in more dropouts;
- A teacher workforce does not exist to meet the demands of more stringent coursework;
- Without additional resources, increased requirements are simply another unfunded mandate;
- The arts and other non-core curriculum would suffer;
- Career and professional education would be sidelined;

[10] ECS has compiled a listing of the state high school graduation requirements for mathematics and science, available at http://mb2.ecs.org/reports/Report.aspx?id=900 and http://mb2.ecs.org/reports/Report.aspx?id=902, respectively. ECS has additionally created a listing of state STEM initiatives, available at http://mb2.ecs.org/reports/Report.aspx?id=1409.

[11] The 17 states are: Alabama, Arkansas, Delaware, Georgia, Indiana, Kentucky, Michigan, Minnesota, New Mexico, North Carolina, Ohio, Oklahoma, Tennessee, Texas, Virginia, Washington, and West Virginia. E-mail correspondence with Jennifer Dounay of the ECS, June 3, 2009.

[12] Email correspondence with Jennifer Dounay of the ECS, June 3, 2009.

[13] *High School Level STEM Initiatives*, Education Commission of the States, available at http://mb2.ecs.org/reports/Report.aspx?id=1409.

[14] *Dispelling the Myths About the Negative Effects of Raising High School Graduation Requirements*, Jennifer Dounay, Education Commission of the States, available at http://www.ecs.org/html/Document.asp?chouseid=7845.

- Postsecondary education is not necessary for all students; and
- Most students do not need four years of rigorous math or specific sciences with lab components.

Understandably, each of these perceived obstacles addressed by the ECS are identical to those issues debated in response to SB 2654 during the 2009 Legislative session. Other organizations have also refuted each of the suggested barriers to added rigor.[15] However, it is essential for states to address K-12 STEM in a more comprehensive approach, which demands long-term benchmarked goals and a cohesive statewide commitment to building the infrastructure, or underlying foundation necessary to ensure success.[16] A viable foundation, for example, would include not only an assurance of certified educators to teach STEM courses, but educators who have the ability to teach in a manner that brings STEM-related content to life for students in the classroom. This instruction would help address student disengagement, increased dropouts, and preparation for the demands of postsecondary education and the workforce.

Commitment to Support a Successful K-20+ State STEM Initiative

In order for the state to develop a talent pool of STEM-educated students to meet the needs of a global economy, a comprehensive STEM initiative must be deployed to build the necessary STEM infrastructure. This STEM initiative would, at a minimum, require a revision to teacher preparation and professional learning opportunities and chronologically involve the following:

- Introduction of developmentally appropriate literacy, mathematics, and science concepts at the earliest stages, prekindergarten through elementary;
- More rigorous and engaging mathematics and science coursework for all middle school students to provide the necessary academic foundations for rigorous high school courses; and
- More rigorous and engaging mathematics and science coursework at the high school level that includes student application of skills in workforce and postsecondary settings.

High Quality Instruction in Mathematics and Science

Publications released over the last decade have criticized many state curriculum standards for both a lack of depth in terms of content coverage, student-centered engagement, and actual application of knowledge and skills. Florida, however, engaged internationally recognized experts and highly-skilled K-12 teachers from the math, social sciences, literacy, and science fields and revised its curriculum standards, now the Next Generation Sunshine State Standards (NGSSS). The resulting NGSSS are designed to sequentially build upon each benchmark in support of advancement to the next level of student learning. While the peer reviews of Florida's NGSSS have been overwhelmingly positive, attainment of the envisioned math and science skills will not occur without transforming the delivery of classroom instruction.[17] In order for students to realize success, instruction in the classroom must fundamentally change to make mathematics and science personally significant to students. Revised instruction would need to include opportunities for students to apply what they learn in everyday settings. Although, the emphasis of STEM-related discussions thus far has concerned the high school grades, student success at the high school level will not be achieved without changing instruction at the elementary and middle grades.[18]

Professional Learning for Pre-K-12 Educators to Support STEM

To provide a talent pool of STEM-educated students to support a viable Florida economy, the state must address the quality of Florida's classroom teachers. Ultimately, the areas of teacher preparation, including alternative

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[15] *NAEP Finds Schools Offerings in Arts Holds Steady*, Education Week, June 15, 2009. *The A–G Curriculum: College-Prep? Work-Prep? LIFE-Prep*, The Education Trust, Spring 2004.

[16] *Building a High-Quality Education Workforce, A Governor's Guide to Human Capital Development*, available at http://www.nga.org/Files/pdf/0905BUILDINGEDUWORKFORCE.PDF.

[17] *The Opportunity Equation, Transforming Mathematics and Science Education for Citizenship and the Global Economy*, Carnegie Corporation of New York, Institute for Advanced Study, 2007, available at http://www.opportunityequation.org/report/urgency-opportunity/.

[18] *Foundations for Success, the Final Report of the National Mathematics Advisory Panel*, U.S. Department of Education, 2008, available at http://www.ed.gov/about/bdscomm/list/mathpanel/report/final-report.pdf. *Keeping Middle Grade Students on the Path to Success in High School*, Southern Regional Education Board, 2009, available at http://www.sreb.org/publications/2009/09E04_Keeping_Middle_Grades.asp.

pathways, professional learning opportunities for Florida's teacher workforce, and the attainment of certification and tenure must be aligned directly to quality instruction for students, sound educational practices, and attention to instructional research as it continues to emerge.

Several recent publications have highlighted the lack of in-depth mathematics and science knowledge required in teacher preparation programs and as a condition for certification, primarily at the elementary and middle grades.[19] In order to realize student success at the high school level, elementary and middle school students must be provided rigorous and effective instruction to establish a core foundation in these academic areas. In support of changes to current practices, the Conference Board of Mathematical Sciences recommends nine semester hours of undergraduate mathematics for elementary teacher preparation and at least 21 semester hours for those individuals planning to teach at the middle grades.[20] The Florida Department of Education (DOE) is currently engaged in a systemwide review of teacher preparation, professional learning, and certification to more clearly align these practices to quality teaching research.[21] Perhaps of greatest importance, the DOE is, for the first time, providing student achievement and learning gains data of teacher graduates to teacher preparation programs so that changes can be made to improve preparation practices and enhance classroom instruction. Florida appears to be a forerunner in the use of student achievement data to direct changes to teacher preparation and professional learning practices.

Another initiative to support the enhancement of instruction in the areas of mathematics and science is the Florida PROMiSE grant.[22] PROMiSE provides funding for professional learning for teachers and administrators to support high quality mathematics and science instruction based on the NGSSS.[23] Presently funded for the second consecutive year, PROMiSE funds are used to provide core knowledge in the NGSSS in mathematics and science and effective classroom instruction.[24] To date, the PROMiSE program has supported professional learning opportunities for more than 412 instructional leadership teams in 43 school districts and will have deployed professional development opportunities for STEM-related training to approximately 12,000 Florida classroom teachers.[25]

To facilitate recruitment of new STEM-related teachers, the Florida Center for Research (FCR) at Florida State University (FSU) has instituted the FSUTeach Program[26] and provides leadership and support to similar programs operating at the University of Florida and the University of South Florida. All three programs are developed based on the UTeach model at the University of Texas at Austin,[27] where undergraduate students majoring in the science, technology, engineering, and math fields are recruited into the teaching profession. These students are provided opportunities to develop and apply effective teaching skills in less traditional and more engaging settings prior to entry into a classroom environment. This teacher preparation model is different than traditional teacher preparation programs in that the emphasis is placed on content knowledge in STEM-related academic domains.

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[19] *Tackling the STEM Crisis: Five Steps Your State Can Take to Improve the Quality and Quantity of its K-12Math and Science Teachers*, Joint Publication by the National Council on Teacher Quality and the National Math and Science Initiative, available at http://www.nctq.org/p/docs/nctq_nmsi_stem_initiative.pdf. *The Opportunity Equation, Transforming Mathematics and Science Education for Citizenship and the Global Economy*, Carnegie Corporation of New York, Institute of Advanced Study, 2007, available at http://www.opportunityequation.org/report/urgency-opportunity/.

[20] The Conference Board of Mathematical Sciences is an umbrella organization consisting of 17 professional societies, which have the increase or diffusion of knowledge in one or more of the mathematical sciences as one of their primary objectives. The board's website is available at http://www.cbmsweb.org/Members/about_cbms.htm.

[21] Staff meetings with acting Division Director of Teacher Quality, Florida Department of Education, July 16, 2009, August 6, 2009, August 27, 2009, and September 2, 2009.

[22] Funding for PROMiSE is provided through the U.S. Department of Education's Mathematics and Science Partnership (MSP) program.

[23] PROMiSE, A Partnership to Rejuvenate and Optimize Mathematics and Science Education in Florida. Information on PROMiSE is available at http://flpromise.org/. CPALMS is an effort coordinated by FCR-STEM at Florida State University within the PROMiSE initiative. CPALMS' website is available at http://www.cpalms.org/about.aspx and a brief screenshot virtual tour is available at http://www.cpalms.org/graphics/flash/screentour/screentour.html.

[24] The PROMiSE initiative was funded at 5.9 million in the first year and $8.1 million in the second.

[25] PROMiSE project summary available at http://flpromise.org/docs/Year1grantproposal.pdf.

[26] FSUTeach website available at http://www.fsu-teach.fsu.edu/.

[27] The University of Texas at Austin's UTeach website is available at http://www.uteach.utexas.edu/.

Teaching pedagogy and instructional methods, while the mainstay of most teacher preparation programs, are integrated into rigorous content knowledge to support instruction that is meaningful to students. In addition to Florida, Arizona, California, Colorado, Kansas, Kentucky, Louisiana, and Pennsylvania have all instituted this model to address the need for STEM-skilled K-12 teachers.

The Importance of Literacy Skills in Relation to STEM Success

While it is important to support PROMiSE and related STEM-professional development initiatives, literacy skills must be included as a standard component in all STEM-related instructional delivery skills for teachers.

According to most studies, the vocabulary alone required for mathematics and science is very different from the vocabulary needed to succeed in other academic disciplines.[28] For example, the terms *photosynthesis* and *negative integers* are unique to science and mathematics respectively. As a result of this research, the 2009 National Assessment of Educational Progress (NAEP) Reading Framework recommends to include a more stringent vocabulary measurement in future assessments.[29]

Providing a Strong Foundation in Prekindergarten (Pre-K) and Elementary Grades to Build STEM Capacity

In order to establish a strong foundation for success in mathematics and science, it is essential to incorporate the literacy skills and direct instruction related to these skills within each academic discipline. Accordingly, Pre-K and elementary teachers must be provided professional learning opportunities to enhance their vocabulary-related instructional skills, and elementary teachers must provide opportunities to their students to apply literacy skills within each content area. These skills will help students navigate increasingly demanding text and to succeed in more rigorous coursework at the secondary level.

Florida's Voluntary Pre-Kindergarten Program (VPK) has established promising groundwork to provide the early learning foundation to support future student success. With leadership provided by the Florida Department of Education, the Department of Children and Families, and the Agency for Workforce Innovation, on-line and face-to-face professional learning opportunities have been developed to facilitate emergent literacy skills for Florida's VPK students. Florida's Kindergarten Readiness Screener assesses the kindergarten readiness skills of VPK students.[30] Students enrolled in VPK programs that embrace emergent literacy skills are far-better prepared academically than children without access to these skills in the early years.[31]

In order to provide the foundation to support a statewide STEM initiative, it is important to provide to Florida's Pre-K and elementary teachers a clear understanding of the sequential nature of the NGSSS and to provide professional learning opportunities that will help them to lay the groundwork for STEM-related academic skills. In support of early grades STEM instruction, the National Research Council urges a focus on developmentally appropriate pre-school mathematics.[32] In advance of the National Research Council's recommendations, Florida's VPK leadership community was prepared to offer professional learning opportunities in the area of emergent mathematics skills, a key to establishing the STEM foundation. Unfortunately, the state's budgetary constraints preempted deployment of this mathematics training component.[33]

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[28] *Reading in the Disciplines, the Challenges of Adult Adolescent Literacy*, Carol D. Lee and Anika Spratley, Northwestern University, available at http://www.carnegie.org/literacy/tta/pdf/tta_Lee.pdf. *What Content-Area Teachers Should Know About Adolescent Literacy,* National Institute for Literacy, available at http://www.nifl.gov/publications/pdf/adolescent_literacy07.pdf.

[29] *Reading Framework for the 2009 National Assessment of Educational Progress*, National Assessment Governing Board, U.S. Department of Education, available at http://www.nagb.org/publications/frameworks/reading09.pdf.

[30] Information on the Florida Kindergarten Readiness Screener is available at http://www.fldoe.org/earlylearning/FLKRS2009.asp.

[31] VPK readiness data is available at http://www.fldoe.org/earlylearning/account.asp.

[32] An overview of some of the professional development and teacher resources is available at http://www.fldoe.org/earlylearning/pdf/ProfessionalDevelopment.pdf.

[33] The DOE estimates the cost for implementation at approximately $50,000.00. The National Research Council has urged the support of developmentally appropriate mathematics activities for Pre-K children. *NRC Urges Greater Focus on Preschool Math*, Education Week, published online, July 2, 2009, available at www.edweek.org/ew/articles/2009/07/02/36early.h28.html.

Focus at the Middle Grades is Essential to the Success of STEM at the High Schools, Postsecondary Education and the Workforce

Within the discussion of STEM-related academic rigor at the middle grades, several research publications have stressed the importance of identifying the signs most often associated with student disengagement. While most students drop out of school at the high school level, student disengagement begins to manifest at the middle grades. As mathematics and science-related curricula become increasingly more demanding at the secondary level, instruction must be more meaningful to students beginning in the middle grades. The instruction must provide tangible connections between rigorous academic expectations, the world as they know it, and an increasingly competitive job market.

Literacy skills must be addressed at every opportunity and should be integrated throughout all content areas in order to support student success in the STEM areas. Accordingly, secondary teachers must be equipped to teach reading in all subject areas. Secondary schools must employ staff who are skilled in the use of effective interventions for struggling readers so that all students can participate successfully in rigorous coursework. Most studies indicate that the teaching of reading skills in the secondary content areas is a necessity, and struggling readers, if given appropriate interventions, can overcome academic hurdles often considered insurmountable.[34] The studies show that struggling readers can and will succeed in demanding courses, when provided with opportunities to apply these skills in coursework that has personal meaning to them.[35]

Florida's Emerging Statewide STEMM Initiative

In 2007, Florida State University was chosen as the site for the Florida Center for Research in Science, Technology, Engineering and Mathematics (FCR-STEM).36 The goal of FCR-STEM is to facilitate statewide efforts to improve teaching and learning in science, mathematics and technology to better prepare students for pursuits in higher education and competitive 21st century careers. FCR-STEM, led by Nobel Laureate Sir Harold Kroto, employs an interdisciplinary, evidence-based approach to improving mathematics, technology, and science instruction in Florida's schools. FCR-STEM is housed within FSU's Learning Systems Institute,37 an interdisciplinary research arm of the university**.**

The National Governor's Association, in a recent response to an FCR-STEM grant proposal, stated that:

> Florida's gap analysis completed for NGA's grant application indicates that the state has many STEM partners, programs, and activities, but they are not well connected, aligned, or working cooperatively to achieve the common goal of improving student achievement in STEM areas. Additionally, despite these multiple STEM programs in public schools, colleges, universities, Space Florida, and STEM-related business and industry, student achievement in STEM content areas and programs is not where it needs to be for students' future success in these areas. Secondary students lack essential competencies to succeed in postsecondary STEM education and 21st Century STEM careers. As a result, employers are looking outside of Florida and the nation to fill high skill STEM positions.[38]

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[34] *Exploring the Relative Effectiveness of Reading Interventions for High School Students*, L. Lang, J Torgeson, et al; National Association of State Boards of Education, State Adolescent Literacy Network. *Supporting Adolescent Literacy Achievement*, The National Governors Association. *Research-Based Content Area Reading Instruction*, Texas Reading Initiative.

[35] *Middle Grades to High School: Mending a Weak Link*, Southern Regional Education Board, available at http://www.sreb.org/programs/hstw/publications/briefs/02V08_Middle_Grades_To_HS.pdf.

[36] Section 59, ch. 2006-60, L.O.F., (codified in s. 1004.86, F.S.) instructed the Department of Education to competitively select a public or private university to create and operate the Florida Center for Mathematics and Science Education Research for purposes of increasing student achievement in mathematics and science, with an emphasis on K-12 education.

[37] Information on the Learning Systems Institute at Florida State University is available at http://www.lsi.fsu.edu/center1.aspx.

[38] As part of the Innovation America initiative, the National Governors Association issued a policy guide for governors on K-12 STEM education entitled *Promoting STEM Education, a Communications Toolkit, Science, Technology, Engineering, and Mathematics*, available at http://www.nga.org/Files/pdf/0804STEMTOOLKIT.PDF. Excerpts from the Florida STEM work proposal were provided by the Learning System's Institute at Florida State University and are on file with the committee.

As a result of the NGA's findings, FCR-STEM launched a partnership with the Florida Chamber of Commerce (Florida Chamber Foundation) to develop a cohesive state plan to engage the educational and workforce entities essential to create and sustain a highly skilled workforce and a more viable state economy. [39] As this comprehensive action plan for systemic reform develops, several significant components have emerged, all equally critical to providing the statewide infrastructure to achieve educational and workforce goals:

- A Pre-K-20+ Vision for Florida's Future;
- Aggressive recruitment of STEM educators;
- Cohesive investment in comprehensive STEM-related professional development for the Pre-K-20 teacher workforce;
- Adoption of more rigorous mathematics and science requirements at the middle and high school grades; and
- Development or acquisition of end-of-course assessments aligned to rigorous math and science courses.[40]

Options and/or Recommendations

In order to make the state globally competitive in mathematics and science, the state needs to make the following revisions in its current practices in the education of its students and the development of its teaching profession:

- Pre-K-20 science and mathematics instruction must be revised to make instruction relevant to students. This requires universities, colleges, education preparation institutes, and school districts to emphasize the actual art of instruction in their curricula for the preparation of teachers.
- Reading skills instruction must be incorporated in all content areas beginning at grade 4 and continuing through grade 12, to support student success in the STEM areas.
- Professional development, teacher preparation programs, and the certification of teachers need significant revisions to develop quality teachers and instruction. Professional development must emphasize instruction that is engaging and meaningful to students. Teacher preparation programs should revise their curricula based on the student learning data of their graduates. Finally, certification to teach in the state should require a candidate to demonstrate a more significant understanding of content.
- The state should aggressively recruit STEM educators from postsecondary institutions and the high-tech business sector. The Department of Education and school districts should determine if there are barriers to recruiting such candidates.
- The Department of Education should continue, within budgetary constraints, its efforts to acquire assessments, including rigorous end-of-course assessments, to identify appropriate instruction.

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[39] *Developing an Action Plan for Systemic Reform of STEMM Education and Workforce Readiness in Florida, A Proposal from the Florida Center for Research in Science, Technology, Engineering, Mathematics, and Medicine*, Dr. Laura Lang, Director of the Learning Systems Institute at Florida State University and Dr. Frank Fuller, Executive Director of the Florida Banner Center for Secondary Education. To date, the following groups have committed to this unified state action plan: Florida Chamber Foundation (www.flchamber.com); The Office of the Governor; University of Central Florida College of Engineering (http://www.cecs.ucf.edu/); Florida Department of Education; The Consortium of Florida Education Foundations (http://www.cfef.net/); Workforce Florida, Inc. (www.workforceflorida.com); The Agency for Workforce Innovation (http://www.floridajobs.org/); Innovation Industry Clusters-Banner Centers (http://www.workforceflorida.com/banner_center.htm); Clean Energy, Life Sciences & Medicine, Information Technology, Aviation & Aerospace, Homeland; The Harris Corporation (http://www.harris.com/); Enterprise Florida (http://www.eflorida.com/); Florida's Great Northwest (http://www.floridasgreatnorthwest.com/); Orlando Chamber of Commerce; Florida Organization of Instructional Leaders (http://floridafoil.com/); Foundation for Excellence in Education (http://www.excelined.org/); Florida Association of District School Superintendents; Florida Association of School Administrators; Florida State Board of Education; The University of South Florida Coalition for Science Literacy (http://www.csl.usf.edu/); The Florida Board of Governors; Brevard, Leon, and Lake County Schools; The Helios Foundation (http://www.helios.org/); Miami-Dade College; The Florida Learning Alliance, Heartland Educational Consortium, North East Florida Educational Consortium (NEFEC), and Panhandle Area Educational Consortium (PAEC); and the Florida Virtual School (FLVS) (http://www.floridalearningalliance.org/).

[40] *High School Level Stem Initiatives*, Education Commission of the States, available at http://mb2.ecs.org/reports/Report.aspx?id=1415.

- The Legislature should require a comprehensive review of current STEM-related funding to ensure that funding is based on sound research and a return on the state's investment, and to eliminate duplication of effort.

In order to address the immediate need for a talent pool of STEM-related education and workforce professionals, the Legislature may wish to consider more rigorous mathematics and science high school graduation requirements, provided that the following prerequisites are in place:

- The education and business communities are certain that appropriately trained educators are available to teach these courses;
- The middle grades coursework is in place to support student success in rigorous mathematics and science at the high school level; and
- The Department of Education is able to provide technical support to districts, schools, and early childhood providers to facilitate comprehensive STEM instruction, based upon research. This assistance must include timely distribution of research findings on STEM instruction, support for STEM-related professional learning opportunities, cost-effective use of existing and future resources, and a return on taxpayer investments.