OVERVIEW OF PROGRAMS

October 16, 2015

About CTL

The New Jersey Center for Teaching and Learning (CTL) is an independent not-for-profit foundation created by the New Jersey Education Association. CTL's mission is to empower teachers to lead school improvement so that all children have access to a high quality education.

CTL uses proven, replicable approaches to teaching K-12 science and math: the Progressive Science Initiative® (PSI®) and the Progressive Mathematics Initiative® (PMI®). They provide students the foundation to pursue science, technology, engineering and math (STEM) careers.

Development of PSI

A journey that began fifteen years ago with the goal of improving science education for 16 pre-engineering students at a New Jersey vocational/technical high school has opened the way for the U.S. to become a global leader in science and math education.

In 1999, Dr. Robert Goodman – CTL's executive director – launched a new high school pre-engineering program for students with weak science and math skills. This need to bring under-prepared students up to a very high standard in science and math is seen across K-12 and in higher education.

PSI, a program that boosts student achievement in science and math, was developed in response to this need. In addition to improving student's math and science scores, PSI helped Dr. Goodman's school become the leader in New Jersey for AP Physics. In

2006, Dr. Goodman was named the NJ State Teacher of the Year, and in 2009 he became executive director of CTL.

The method to teaching and learning that was developed at Bergen Tech -Teterboro, NJ in 1999 became the PSI-PMI approach to science and math education. This method is also at the core of that school's transformation from being a typical vocational-technical high school when it began in 1999 to, in 2015, being rated #32 by US News and World Report and #12 by Niche, out of 14,000 U.S. high schools.

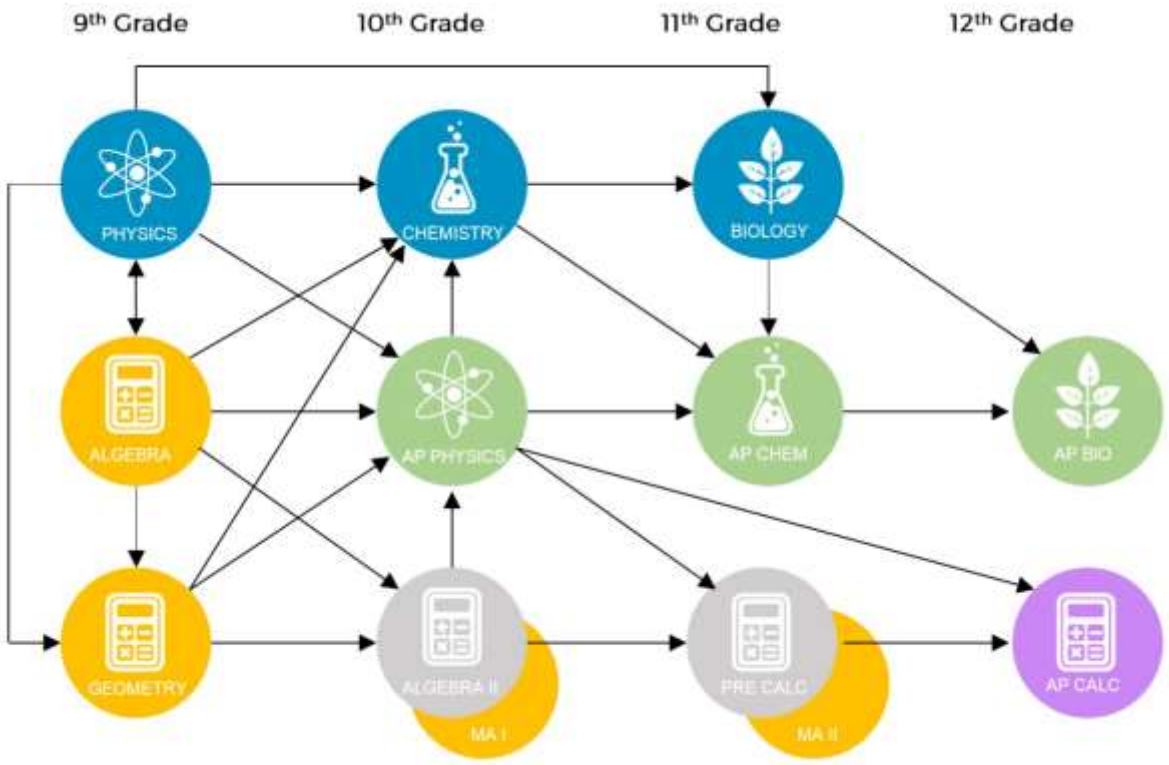
Why PSI is Unique

PSI combines direct instruction and social constructivism to create an engaging environment for students, regardless of their prior experience with science and math. The classroom is filled with lively debate and collaborative problem solving. It makes science and math the favorite subjects of many students as they achieve exceptional understanding.

This is very much in line with the award-winning work of Carl Wieman and Eric Mazur in improving the teaching of science at institutions of higher education. Their use of student polling devices, formative assessment and heightened student engagement in the university lecture hall represents a direct analog of the work of PSI in the K-12 classroom. These approaches have proven successful for students of all ages.

Another key aspect of PSI is correcting the science sequence to physics-chemistry-biology, a change from the traditional biology-chemistry-physics sequence. The traditional sequence made sense when it began in 1892, but had not changed since the advent of quantum theory and molecular biology more than 50 years ago. The PSI sequence helps science make sense to students.

A New Sequence of Stem Subjects – with APs



Students learn algebra-based physics at the same time as algebra; therefore they experience meaning and context to math in a way that is generally missing to students in traditional programs.

Expansion of PSI

NJ policy makers supported bringing PSI to more schools. Expansion required course materials that could be broadly shared, and it also required more physics teachers – many more.

Course materials were created by capturing the content and pedagogy of PSI in interactive whiteboard software. Use of interactive whiteboards and student polling devices enables the blending of curriculum, pedagogy and assessment into a seamless whole. It also allows for easy replication of that experience via downloading and using PSI's free editable electronic files.

The PSI methodology, used to teach physics to students, was also employed to teach physics to teachers, helping to grow the pool of qualified physics instructors.

CTL quickly became the #1 producer of physics teachers in the United States. Those teachers have led their schools to become top schools for students taking AP sciences. PSI first proved that all students could learn physics. It has now proven that teachers from any subject area can learn physics. And that they can teach it successfully.

Expansion of PSI to K-12 Math and Science

Common Core Mathematics Standards (CCSS) offer the same curriculum coherence for K-12 math as PSI has for high school science. By applying the same methods for teaching and learning that were developed for PSI to mathematics, PMI was created.

PMI now provides free editable content for teaching math from kindergarten through grade 12.

More recently, Next Generation Science Standards (NGSS) began providing that same curriculum coherence to K-8 science. CTL used that opportunity to expand PSI science course materials to those grades – providing editable free science course materials from kindergarten through the AP sciences.

Offering complete sets of free editable course materials for all of K-12 math and science eliminates the expense of textbooks and allows real-time continuous improvement. It also provides K-12 vertical alignment, from year to year, and horizontal alignment, between math and science in each year. This provides unprecedented coherence, which as never before been possible.

Teacher Training

In addition to creating new physics and chemistry teachers, CTL trains K-12 teachers to use its course materials. Teachers must teach in a new way to realize the full benefit of this new instructional and learning paradigm; they must deliver brief direct instruction (5 to 10 minutes), pose questions that drive collaborative student problem solving, provide feedback on classroom results and then set up the next problem. Instructors must inspire the continuous improvement of student understanding. To a great extent this involves teachers setting up the experience for students and then allowing students to take the lead. By June of 2015, more than 1,500 certified math and science teachers had been trained in PSI and PMI methods; 150 teachers will have completed a physics teacher endorsement; and 36 teachers will have completed a chemistry endorsement. CTL is "on the ground" in 218 schools in New Jersey, Colorado, Utah, Rhode Island, Vermont, Maine, Argentina and The Gambia.

Sustainability

Sustainability is a core value of CTL. It is reflected in how we operate and in our programs. PSI and PMI eliminate textbooks, providing savings to schools which quickly repays investments in training and technology and, thereafter provides lower education costs. It also reduces the environmental impact of printing, shipping, and storing textbooks while allowing the real-time continuous improvement of course materials.

CTL has no building; all employees work from home and are connected electronically. This lowers cost and eliminates wasted commuting time. It also is environmentally sound. The “greenest” building is no building; the most environmentally friendly commute is no commute. Extensive and ongoing research and program evaluations provide the documentation that allows for the continuous improvement of PSI and PMI as well as growing support from the educational, business and philanthropic communities.

Accomplishments

CTL is the #1 producer of physics teachers in the United States. We are opening access to STEM career paths to many who would otherwise not have it, particularly students who are Black/Hispanic and/or live in economically depressed circumstances. In 2014, PSI was used in eight of the top twenty NJ schools for 2014 AP Physics B participation. CTL schools are more than 60% Black/Hispanic and free/reduced lunch; non-CTL schools are less than 10%.

AP Physics B Participation – NJ
2013 – 14

Rank	School	AP B Participation	Black Hispanic	Econ. Disadv.
1	BERGEN COUNTY TECHNICAL HIGH SCHOOL - TETERBORO	47.3%	24.4%	11.7%
2	LIBERTY HIGH SCHOOL (JERSEY CITY)	37.6%	77.1%	62.2%
3	GLEN RIDGE HIGH SCHOOL	24.2%	12.0%	0.0%
4	TECHNOLOGY HIGH SCHOOL (NEWARK)	24.2%	89.5%	90.6%
5	BERNARDS HIGH SCHOOL	23.8%	15.5%	8.8%
6	MADISON HIGH SCHOOL	23.8%	11.2%	7.2%
7	CRESSKILL HIGH SCHOOL	23.6%	9.5%	4.2%
8	DR RONALD MCNAIR HIGH SCHOOL (JERSEY CITY)	22.6%	38.2%	47.0%
9	CHATHAM HIGH SCHOOL	22.3%	4.8%	2.2%
10	HIGHLAND PARK HIGH SCHOOL	19.4%	31.7%	33.0%
11	BERGENFIELD HIGH SCHOOL	19.2%	51.6%	35.0%
12	HENRY HUDSON REGIONAL SCHOOL	17.7%	8.3%	26.6%
13	RIDGE HIGH SCHOOL	16.3%	4.3%	1.3%
14	RAMAPO HIGH SCHOOL	15.1%	4.3%	0.4%
15	EAST ORANGE STEM ACADEMY HIGH SCHOOL	14.7%	99.6%	73.6%
16	AMERICAN HISTORY HIGH SCHOOL (NEWARK)	14.2%	96.7%	85.4%
17	MOORSETOWN HIGH SCHOOL	14.2%	11.9%	9.7%
18	PERTH AMBOY HIGH SCHOOL	13.7%	97.4%	84.3%
19	MONTGOMERY HIGH SCHOOL	13.4%	5.7%	3.8%
20	ROBBINSVILLE HIGH SCHOOL	12.6%	7.4%	4.8%
	PSI		71.8%	61.2%
	Non-PSI		10.6%	8.5%

CTL is improving math achievement through its work in physics. For example, Newark's 9th grade students who took physics saw a 14% improvement on a national Algebra I exam.

In 2014-15, CTL provided physics endorsements to 11 current Trenton Public School teachers so that they could teach mathematically rigorous physics to about 600 students, the majority of whom were in grade 9. In 2015-16, those students are all moving on to chemistry and a group of those will be taking AP Physics 1 at the same time as chemistry; the first time AP Physics has been taught in Trenton.

For 2015-16, CTL provided physics endorsements to 6 current Camden Public School teachers and is training/supporting 9 other science teaches so that, together, they will teach mathematically rigorous physics to all Camden 9th graders, more than 1000 students.

In 2014-15, Westminster High School, in Colorado, had its first year of fully implementing PSI Algebra-Based Physics, piloting the course with 11th grade students. The results were so positive that for 2015-16 the teachers successfully urged the district to reverse the science sequence and offer that course to all 600+ ninth graders, along with a similar number of 11th graders.

PSI physics began in one classroom in 1999 at Bergen County Technical High School in Teterboro, NJ. Then, Bergen Tech was just beginning to add academic courses to become a full-time county vocational school. Now, U.S. News and World Report ranks it among the top 3 schools in New Jersey and Niche ranks it as number 12 out of 14,000 public schools in the nation. https://k12.niche.com/rankings/public-highschools/best-overall/

The Stanford Center for Opportunity Policy in Education, headed by Linda Darling-Hammond, said, "The New Jersey Center for Teaching and Learning (NJCTL) has been doing groundbreaking professional development work in math and science instruction as well…using the innovative curriculum of 2006 New Jersey Teacher of the Year Robert Goodman…to create the Progressive Science Initiative."

CTL received a 2011 Learning Impact Award Gold Medal from IMS Global. IMS, a consortium of more than 150 education technology companies, awards this each year to those that have had the greatest impact on student learning.

CTL, in the last five years, has extended its work to more than 218 schools in New Jersey, Colorado, Utah, Rhode Island, Vermont, Maine, The Gambia, and Argentina; more than 1,430 teachers have been trained in CTL methods and 175 teachers have completed teacher certification in physics or chemistry. Approximately 2.5 million students learned from CTL's content in the last twelve months. That estimate is based on 1.7 million file downloads by 260,000 unique visitors, from 50 states and 194 countries. Also, during that period, CTL's 1,759 posted videos had more than 68,000 views, representing about 112,000 minutes of viewing. Beginning in July, 2015, a 3-year,

$1.3 million project, funded by the World Bank and the Ministry of Basic and Secondary Education of The Gambia, was begun to develop English Language Arts (ELA) courses for West Africa. The Gambia has experienced dramatic success in a three year pilot of PSI and PMI for teaching mathematics and science and is extending those programs to all students in grades 7-12. They now want to use that same approach for teaching ELA.

Looking Forward

While much has been accomplished, there are challenges to address and much more to do.

CTL's initiatives have grown rapidly, but they only meet a very small part of the need for math and science education. Expansion to new geographic markets will require new partners and an investment in traveling to and communicating with those markets.

Course materials need constant maintenance and improvement as new assessments are needed each year and as user suggestions need to be incorporated. In addition, materials based on recently developed standards need updating and as new guidance and sample problems are released: examples include the CCSS for mathematics, NGSS for science and AP standards for math and science. Also, realizing the full potential for vertical and horizontal alignment of curricula takes constant study, reflection and implementation. Generally, realizing the potential of real-time continuous improvement of materials is an ongoing effort.

Technology needs to be constantly improved, and new ways to deliver instruction to students must continuously be studied and, as appropriate, incorporated.

Computer Science represents a third strand of curriculum that would complement CTL's current courseware in science and mathematics. It would provide a parallel means of teaching analytic thinking and opening access to STEM careers. This additional strand is a logical next step for CTL.

Research is needed to both confirm current data and increase their depth and thoroughness so as to more clearly explore the mechanism by which reported gains have been achieved. For instance, the publicly available data used in research to date is only at the school level, not at the teacher level or the student level. Research at those levels would support the continuous improvement and scalability of CTL's programs.