



## *Integrated Academic and Career/Technical Learning Shows Real-Life Applications of Education*

Southern Regional Education Board, 592 10th St. N.W., Atlanta, GA 30318, (404) 875-9211, [www.sreb.org](http://www.sreb.org)

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Students who see the connections between academic subjects such as English/language arts, mathematics and science on the one hand and career/technical courses on the other are more apt to believe high school is important to their lives. Increasingly, schools are using real-life approaches and hands-on projects to blend academic and career/technical content in making learning more authentic for students.

### **Projects Connect Students to College and Community**

When leaders and teachers at **Grundy County High School (GCHS)** in Coalmont, Tennessee, joined *High Schools That Work (HSTW)*, they accomplished a number of things — using data to set higher standards, combining academic and career/technical (CT) studies, offering guidance and extra help, and supporting students in completing service learning projects that extend the classroom into the community.

“Our entire school culture has changed,” said **Golda Colquette**, assistant principal and director of CT education. “We have faculty buy-in and ownership for implementing the *High Schools That Work* Key Practices.”

GCHS enrolls 726 students in a rural, economically disadvantaged county east of Nashville. Almost 100 percent of students are white, and 90 percent are completing CT pathways.

The school received a Gold Improvement Award from the Southern Regional Education Board (SREB) in 2007 for making significant gains in student achievement in reading, mathematics and science on the *HSTW* Assessment between 2004 and 2006 and meeting the Adequate Yearly Progress (AYP) criteria of *No Child Left Behind*.

Common planning time for teachers has resulted in many integrated projects to show the connections between academic and CT content.

- **Alternative Fuel** — One project involves agriculture and physical science students in producing bio-diesel fuel. Welding students lend a hand by helping assemble the system, which can produce 40 gallons of fuel every 12 hours. So far, the system has produced close to 1,500 gallons for use in tractors and mowers. The physical science standards that students met in doing the project included selecting appropriate tools and technology to collect precise and accurate quantitative and qualitative data; investigating chemical and physical changes; using appropriate units to measure or calculate the mass and volume of substances; and identifying a substance as acidic, basic or neutral based on its pH or response to an indicator or instrument. When word spread about the project, a nearby college asked GCHS students to conduct a workshop on bio-diesel fuel for its agriculture students. “How many high school students can say they have taught a college class?” asked **Donivan Stockwell**, agriculture teacher and *HSTW* coordinator at GCHS.
- **Recycling Project** — Students launched a recycling project in 2007 when they conducted an audit of how energy was being used at the school and how it could be conserved district-wide. The findings led to a project in which students have collected thousands of pounds of plastic bottles, paper and cardboard for recycling.
- **Business Directory** — Science teacher **Brian Masters** and his service learning students received a \$3,000 grant from The University of the South in Seawee, Tennessee, to publish a directory containing information about businesses in Grundy County and an adjoining county. The students contacted business owners to sell advertisements to help with the cost of printing in the future. They also researched the histories of the two counties and wrote profiles to include in the directory. Art students designed many of the ads. The purpose of *The Gateway to the Cumberland* project was twofold — to highlight local businesses and to show the types of enterprises that are needed in the area. “It’s possible that some of our students might decide to fill that need by starting businesses of their own,” Masters said.

“Our entire school culture has changed. We have faculty buy-in and ownership for implementing the *High Schools That Work* Key Practices.”

— **Golda Colquette**  
*Assistant Principal*

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## House and Garden Projects Maximize Student Learning

Many schools work to raise student achievement by creating new variations of the house and garden projects that have typified hands-on learning for so many years. Here are examples from four schools:

**An Energy-Efficient “Green” House** — Green is the way things are going across America — and the same is true in a special project at **Lancaster County Career & Technology Center** (LCCTC) in Brownstown, Pennsylvania.



Green is the way things are going across America.

Students in building and construction-related programs at this shared-time facility for 12th-graders are completing an environmentally friendly house that is estimated to be 50 percent more energy efficient than a traditional house constructed five years ago. The first such home in Lancaster County and the first of four the center plans to build over the next few years is approximately 2,500 square feet with four

bedrooms and two and a half bathrooms on two floors, plus a basement. It is on the tech center campus.

In partnership with the National Association of Home Builders (NAHB) and other groups, the students used modern energy-efficient techniques in learning a new way to build. They combined knowledge of mathematics, science and technical studies to modify an existing house plan to contain “green” technologies such as advanced framing techniques, fiber-cement siding, sprayed fiber insulation, rainwater harvesting, solar water heaters, tubular skylights, whole-house mechanical ventilation strategies and xeriscaping. All of the building tasks except drywall hanging were performed by students using knowledge and skills learned in their career/technical (CT) programs: computer-assisted drafting and design, electrical, plumbing, cabinet making, heavy equipment operation and landscaping.

In partnership with the Lancaster Building Industry Association and the National Energy Education Development (NEED) project, the community venture will:

- develop a model for green building and its impact on industry, education and the community.
- conduct professional development workshops for high school and middle grades teachers and CT instructors on green building technologies and associated mathematics and science concepts.
- train 200 CT students annually to provide leadership for the building industry.

- revise the building and construction program curriculum to include training in green building and the latest technological advances in residential building.
- provide a joint energy education program that aligns with academic standards for mathematics, science and technology.
- educate local builders to the benefits and challenges of environmental design and construction.
- lead the community to improve the durability, affordability and environmental performance of homes in the county through the integration of academic, CT and community education.

The building green project has received awards from the county, the state and NAHB for its effectiveness in demonstrating energy conservation and utilization. The public will be invited to tour the home as part of students’ efforts to educate the community about conservation. LCCTC plans to place a video of the project on its Web site at [www.lcctc.org](http://www.lcctc.org).

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**Construction Geometry** — Carpentry, welding, machine tool and agriculture students who take Construction Geometry at **Henderson County High School** in Henderson, Kentucky, put their integrated mathematics skills to use each year in building a house they sell in the community. Mathematics teacher **Beth Roberts** helps prepare students for this hands-on experience by teaching practical applications of mathematics concepts such as the Pythagorean Theorem, triangle measurement, right angles, diagonals and rise-and-run calculations.

In one project, students draw a plan for a three-bedroom house that will satisfy a building inspector’s requirements for mathematical accuracy, architectural neatness and livability. Students earn extra points for designing a home that is wheelchair accessible. Henderson County High School uses MAP (Measures of Academic Progress) tests from the Northwest Evaluation Association to measure student achievement. A comparison of Construction Geometry students’ scores from spring 2007 when they were sophomores to spring 2008 when they were juniors showed that 48 percent advanced five points or higher and 33 percent scored 10 points or higher than the previous year on the MAP mathematics test. Eight students had an increase of 15 points or higher from one year to the next on the MAP mathematics test.

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**A House Is Not a Home** — The department heads for CT education, English/language arts, mathematics, science and social studies at **Worthing Senior High School** in Houston, Texas, took the lead in involving teachers and students in a schoolwide interdisciplinary academic enrichment project titled “A House Is Not a Home.” Career/technical students created PowerPoint presentations featuring drafting and design projects based on students’ own homes, including blueprints and scale models. English/language arts students read the play *A Raisin in the Sun* and the book *The House on Mango Street* to write an essay and create a visual interpretation comparing the literary homes with their own “dream homes.” They used pre-writing strategies for the comparison and were required to meet state standards for essays, including maintaining voice and style. Students in Algebra I used floor plans for a two-story house to apply mathematics concepts of dimensions and measurement. They used appropriate mathematical terms to explain their choices of paint and carpeting. Science students conducted experiments related to the ecology of a modern house. Working in teams, they researched the energy efficiency and ecological health features of today’s homes. The students also examined and evaluated solar panels for their function, cost and conservation benefits. In social studies classes, students created dioramas depicting the interiors of homes at various times in history.

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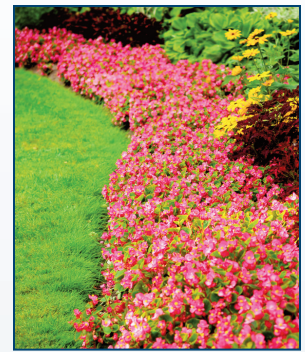
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**A Garden on Campus** — Teachers at **Powhatan High School** in Powhatan, Virginia, worked with ninth-grade English/language arts teacher **Tracey Ingle** to develop an integrated project resulting in a peaceful garden on campus. Pavel’s Garden is filled with walkways, rest areas, live plants and butterflies. The project was sponsored by a grant from Partners in the Arts, a program of the Richmond Arts Council.

Two artists were invited to help students work on various hands-on projects. The garden was inspired by the book *Night* by Elie Wiesel, who wrote about his life in a concentration camp, and by a poem written by a Jewish youth named Pavel who also lived in such a camp. The poem was “The Butterfly,” from the book *I Never Saw Another Butterfly*. Three ninth-grade teams worked with artists to write poems and to create a dance and other works

of art related to the Holocaust theme. Students who ordinarily would have had no interest in studying the Holocaust and modern-day genocide were very engaged with the themes and topics being discussed in class because of their involvement in the garden project. Students in the following classes at Powhatan took part in the project: Agriculture II, Culinary Arts, Welding, English/language arts, Algebra I, Biology II, Model United Nations, Art II and IV, and Physical Education 9. In each class, students worked on activities and projects related to the Holocaust and the Pavel’s Garden theme. “With so many classes involved, students talked about their activities and were motivated to work harder in each class,” said **Tracey Ingle**, English standards of learning coordinator.



“Students were able to see connections across the curriculum that revealed to them the meaning and purpose of their high school studies.”

— Tracey Ingle  
*Coordinator*

Students did research, heard guest speakers, wrote poems, created a metal sculpture and added wooden benches and decorative stones to the garden. They raised butterflies from larvae. “Students who normally had no interest in poetry were motivated to write some of the most profound lines I have ever read,” Ingle said. “Students who were usually quiet and shy broke out of their shells and did a creative presentation for the entire class.”

The outcome was an integrated project that produced a campus sanctuary and raised students’ knowledge, skills and awareness. “Students were able to see connections across the curriculum that revealed to them the meaning and purpose of their high school studies,” Ingle said. “They were able to discuss similar topics in different ways in many of their courses.” Teachers saw the value of the project and plan to continue it in the current school year.

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## The Way to Higher Achievement May Be Through the Stomach

**F**resh corn puffs...grilled salmon steaks...sweet potato cakes...Indian bread. These tempting dishes were on the menu when students from social studies and culinary arts classes at **Penta Career Center** in Perrysburg, Ohio, engaged in a joint project to learn more about different cultures by studying their favorite foods.

This modern career center in Toledo enrolls 1,350 students from 16 feeder schools in academic and career/technical (CT) programs in grades 11 and 12. An additional 3,000 students are served through satellite programs. With 35 CT programs, Penta is the third largest career center in Ohio.

The first joint project focused on Native Americans. While 11th-grade social studies students taught by **Dave Harms** created a wiki, a free Internet site where information can be published and shared, the culinary students under the direction of **Chef Jim Rhegness** learned to prepare recipes from *The Art of American Indian Cooking* by Yeffe Kimball and Jean Anderson.

Social studies students put basic information on Native Americans (where they lived, what they wore and interesting things about their culture) on the wiki, along with photos and links to other Web sites. They obtained the wiki from Pbwiki Inc. at pbwiki.com. The social studies students also produced PowerPoint presentations and projects to educate the culinary students about the Native Americans that created the recipes the students were learning to cook.

The culmination of the project came when the social studies students went to the culinary arts department to learn how to cook the native dishes and to sample the food. In the future, the social studies students hope to videotape the culinary students for presentation on the Web site.

Chef Rhegness developed a rubric to let students know what would be expected of them and to grade students on various aspects of the project, such as organization, presentation, cooking methods, ingredients and taste.

The project benefited students in a number of ways: They acquired in-depth knowledge of early Americans and the foods they ate; they gained self-confidence in their research, Internet and culinary skills and in showing other students what they had learned; they developed valuable presentation and communication skills; and they learned the real-life connections between academic and CT studies as they interacted with students in other disciplines. The experience prompted some students to learn more about their own heritage by collecting family recipes and bringing them to school.

“This project definitely took writing and accuracy to a new level in my class,” Harms said. “Students realized that others would be reading what they put on the Web site and that it needed to be grammatically and factually correct.”

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## Baking Instructor Cooks Up a Batch of Literacy Skills

Instructor **Linda Grim** of the Retail Commercial Baking Program at **Bethlehem Area Vocational Technical School** in Bethlehem, Pennsylvania, lists the benefits of literacy to her students as she would the ingredients in a favorite dish: higher scores; better attendance and behavior; larger postsecondary enrollment; stronger work ethic; and better reading, writing, listening and speaking skills. The focus on literacy is a major reason that 100 percent of students in the program earned National Occupational Competency Testing Institute (NOCTI) certification in 2007-2008, Grim said.

Each day begins with a five-minute team talk in which students take turns sharing inspirational quotations from sources such as *Bits & Pieces* magazine. The class practices listening to the speaker, writing the quotation and their reactions in a journal, and discussing their interpretations and opinions. At the end of the quarter, students write an essay on their favorite quotation. Grim encourages students to think of the essay as a “great meal.” The opening is the appetizer, the body is the entrée, and the closing is the dessert.

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Students also use fiction to build their literacy skills. One example is the mystery series by Diane Mott Davidson that uses food as the theme and includes recipes in each book. As a class project, students prepared the recipes in one of the books, created and printed new recipes, assembled a scrapbook and calculated the cost of each recipe. During Career and Technical Education Week, held in Harrisburg at the state capitol building, students demonstrated the recipes, distributed recipe cards, frosted a wedding cake and provided information on the literacy strategies involved in reading and comprehending the book.

Grim has also found a place for motivational texts in her classroom. In addition to building literacy skills, Grim says the activity increased the unity of students, improved teamwork and created excitement in the classroom.

Students in the baking program also read newspapers, trade magazines and cookbooks. They write a research paper each year.

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## Mathematics Adds Up at Career/Technical School

Mathematics and career/technical (CT) instructors at **Tri-County Regional Vocational Technical High School**, a *HSTW* Pacesetter School in Franklin, Massachusetts, have devised some lively and effective ways to help students relate mathematics concepts to their CT studies and their own lives. Essentially, they have found ways to make abstract concepts accessible to diverse learners, who actually enjoy stepping up their mathematical skills.

An instructional strategy may be as simple as singing a mathematics principle in rhyme to the tune of “Row, Row, Row Your Boat” or “Pop Goes the Weasel,” as mathematics teacher **Matt Murphy** does. Or it may involve teaching Ohm’s Law by using an outline drawing of a chicken, a technique that mathematics teacher **Cliff Pedersen** obtained from shop teachers.

Carpentry instructor **John Lavigne** boosts the mathematics skills of students by asking them to calculate which house paint is the best value through analysis of unclear pricing in retailer advertising fliers. He teaches the concept of slope by taking students outside the building to participate in mathematics exercises that they complete and then discuss. “When you demonstrate something by using the students themselves, they remember it,” Lavigne said.

Pedersen gives prizes to students who win in a blackjack-type game he calls “mathjack.” Murphy uses a competition based on bowling to engage students and to increase their levels of learning. “It’s amazing to see what students will accomplish when they are called on to think and to do,” Murphy said.



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## Immersing Academic Teachers in Career/Technical Programs

What better way for teachers, counselors and administrators to learn about career/technical (CT) programs than to take a mini-course in which they complete CT lessons and projects and develop integrated lesson plans?

That is the formula for success in the **Mineral Area College Tech Prep Consortium** in southeast Missouri. Some 300 educators over the past five years (including 25 percent to 40 percent repeat attendees) have participated in the program, which involves four area CT centers.

These educators experience professional development and two CT programs in a one-week period in the summer.

The available programs are automotive technology, auto collision and repair, building trades, welding technologies, graphic communication arts and electronics/robotics.

College credit is available to participants for bachelor’s, master’s, specialist and doctoral degree programs. Stipends are provided.

**David Ruhman**, director of **Arcadia Valley Career Technology Center** in Ironton, Missouri, one of the participating CT facilities, outlined benefits of the program. “Administrators, teachers and counselors from feeder high schools develop a better understanding of what happens on

a career/tech campus,” he said. “They learn how to guide students into appropriate career/tech programs and to work with career/tech instructors to create lessons that combine academic and career/tech skills.”

The participants also learn how to answer the student question: “Why do I have to learn this?” Hands-on projects at the summer institute, such as building robots and repairing automobiles, reveal to students the importance of reading, writing, mathematics and science in mastering CT concepts.

**Lisa Ruhman**, a science teacher at **Arcadia Valley High School**, said teaching educators about robots is cutting edge. “Robots are the technology wave of the future in manufacturing, the military and other fields,” she said. She used the robotics module from the program to teach summer-session students from **Arcadia Valley Middle School** how to assemble motherboards, solve malfunction problems and solder component parts. In the 2008-2009 school year, she will incorporate robotics into physical science and earth science courses at the high school.

David Ruhman had a suggestion for educators who lack access to a summer institute like the one in Missouri: “Visit the nearest career/tech center and ask the instructors for ways to incorporate real-world applications of textbook instructional materials,” he said. “Then develop a partnership that will result in more real-world applications of academic lessons in daily classroom activities.” This approach will help students understand why they need to take high-level academic courses and will help teachers use more authentic examples in their instruction.

Samples of integrated lesson plans and slides of some products developed at the summer institute in Missouri are available online at [www.av.k12.mo.us/AchievingExcellence/summer04/index.html](http://www.av.k12.mo.us/AchievingExcellence/summer04/index.html) and at [www.cape.k12.mo.us/cc](http://www.cape.k12.mo.us/cc). (Click on 2008 Tech Prep Summer Institute Files on the left side of the page.)

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## Small Learning Communities Connect Content to Real World

Career-focused programs of study are successful in helping students connect learning to the real world and make the transition from high school to the workplace and further learning. High schools, particularly those enrolling large numbers of students, are finding that small learning communities provide the structure to support career-focused programs of study. When these schools-within-schools have career themes, they are known as career academies.

The first step in building a career academy is to select a theme and develop a vision or mission statement. Most career academy themes are broad in scope: business and finance; health and human services; arts and communication; and mathematics, science and technology. “The mission statement should reflect a commitment to improve student achievement through rigorous academic preparation and rich career-related learning experiences,” said **Heather Sass**, school improvement consultant for the Southern Regional Education Board (SREB).

“While the process of developing and sustaining a career academy can be complex, the rewards are great in terms of student achievement, graduation rates and postsecondary success.”

— **Heather Sass**  
*School Improvement Consultant*  
*SREB*

A school may decide to offer a number of academies in a wall-to-wall configuration involving all students and all teachers, or it may create pocket academies to serve specific groups of students in a few career areas. Teachers are assigned to teams and are given common time in the schedule to plan integrated learning.

The program of study for each academy includes a rigorous core of academic courses and a concentration of at least four courses in a chosen career pathway. The National Career Clusters project offers 81 sample programs of study connected to 16 career clusters on its Web site at [www.careerclusters.org](http://www.careerclusters.org).

“Academic and career/technical teachers must have time to design multiple approaches to integrated learning,” Sass said. “Effective career academy projects are based on real-world scenarios and are targeted to academic and career/technical standards.”

Students need to participate in a variety of career-related experiences, such as job shadowing, field trips, speaker presentations and career fairs. The experiences should become longer and more complex as students increase their knowledge and skills and gain a greater understanding of the workplace. Internships, mentorships and apprenticeships are examples of higher-level work-based learning.

“While the process of developing and sustaining a career academy can be complex, the rewards are great in terms of student achievement, graduation rates and postsecondary success,” Sass said. She cited a number of resources for schools wanting to implement small learning communities, including the National Career Academy, the Northwest Regional Education Laboratory and SREB.

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## Quick Reorganization Converts One School Into Five Academies

**B**el Air High School in El Paso, Texas, made the transition from a traditional four-year comprehensive high school to a facility with five clearly defined academies, or small learning communities, in just one year. The original fear was that performance might decline, but that was not the case. Students' scores on state accountability tests rose between 2005, prior to the transition, and 2008 in all four categories — reading, mathematics, science and social studies. The school's attendance rate was 93.6 percent in 2007-2008. The graduation rate rose from 79.7 percent in 2007 to 83.6 percent in 2008.

Bel Air's five career-themed academies are arts, communications and media; business and technology; health professions; mathematics, science and engineering; and professional and public services. Each academy has 400 to 500 students. A total of 2,100 students are enrolled at Bel Air, with more than 95 percent Hispanic students.



**ARTS, COMMUNICATIONS  
AND MEDIA**



**BUSINESS AND  
TECHNOLOGY**



**HEALTH  
PROFESSIONS**



**MATHEMATICS, SCIENCE  
AND ENGINEERING**



**PROFESSIONAL AND  
PUBLIC SERVICES**

Using the *HSTW* Key Practices as a guide, the school prepared a leadership team in each academy to ensure semiautonomy and high-quality studies; wrote common syllabi for each core course; provided common planning time for teachers to develop integrated projects and review student work and teacher assignments; and established an advisory program to give each student an adult advocate. A redo policy encourages students to improve their work to meet standards.

During the first year, the school launched a high-profile literacy program that included time for reading during the school day. Each student was tested to determine his or her reading level so that reading materials would be appropriate and challenging.

“Moving to wall-to-wall academies in one year has been very productive,” Principal **Marvyn Luckett** said. “The transition was quick and less agonizing for those that were tied to traditional ways of operating a school. We learned the value of communication and planning in advance as well as constant communication during and after the change took place.”

Bel Air High School has used a split block schedule (since discontinued) and a late starting time and is introducing common conference periods in the 2008-2009 school year to give teachers opportunities to work together to plan instruction and critique student assignments.

The split block schedule involved dividing the last 90-minute block of the day into two 45-minute periods and requiring students to take electives during those times. This approach allowed core content teachers to meet in core assignment groups, cross-grade groups or same-grade integrated groups. However, the split block fell out of favor with teachers, who missed longer, more in-depth classes.

The second scheduling change occurred when the school received permission from the school district board of trustees to begin school 30 minutes late each Thursday. On these days, teachers meet in academy teams from 8 a.m. to 9 a.m. They use the time to plan interdisciplinary projects, collaborate on the progress of students they share, and build a more tightly knit and more clearly focused small learning community.

Beginning in 2008-2009, teachers will have time during the school day for grade-level teams to meet in each academy. The late-start schedule will be used for departmental meetings as well as academy meetings to ensure horizontal and vertical alignment of the curriculum.

The school's commitment to teacher planning time has resulted in a number of integrated projects. One example is a unit on body piercing and tattooing developed by teachers in the health professions academy. Students researched the health, historical, economic and social impacts of piercing and tattooing and produced a DVD to report their findings.

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## Inner-City Students Flourish in Business-Related Academies

**Norman Thomas High School**, a large academic high school in New York City, operates in small learning community academies, all of which are business related. Students can opt to “major” in accounting, office technology, marketing (film, fashion, sports) or hospitality/tourism in grades 10 through 12. As ninth-graders, all students begin their business education by taking two introductory courses designed to prepare and assist them in selecting a major.

*“The High Schools That Work design enables teachers and students to make personal connections and the staff to work closer with parents.”*

— Evdoxia Darios  
HSTW Coordinator

Academy teachers meet regularly to develop interdisciplinary projects that connect academic and career/technical learning. Professional development has shifted from content-specific to career-connected.

The academies allow groups of teachers to work with specific groups of students, getting to know them in ways that are impossible in regular large high schools. “The *High Schools That Work* design enables teachers and students to make personal connections and the staff to work closer with parents,” said HSTW coordinator **Evdoxia Darios**. “It has also impacted attendance, behavior and achievement.”

In 2008-2009 the school will expand a program in which each teacher serves as a mentor and advocate for a small group of at-risk students. These teacher-mentors examine students’ schoolwork and grades, contact parents as needed and help students move toward graduation.

The school maintains strong partnerships with employers, community leaders and higher education personnel, particularly those from two-year colleges. Business partners meet with teachers and students on an ongoing basis to help the school evaluate and improve its programs of study.

When advisers from the hospitality industry recommended that students needed stronger presentation skills, teachers changed their assignments and assessments to meet that need. Business partners also contributed. A cruise line hosted tourism students for lunch aboard ship to show them what employees in that business need to know and do.

Strides were made in the first year of wall-to-wall small learning communities, and the groundwork has been laid to make even greater progress in the second year (2008-2009). A faculty survey showed that an overwhelming majority of teachers see positive effects of the academies on students and themselves.

“The experience of using career academies to enhance academic achievement was a success for students, staff and business partners in the first year,” Principal **Steven Satin** said.

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## Teachers Help Academy Students Get Into Science

Science teachers **Ruth Truluck** and **Michele Powell** of **Wando High School**, a suburban school of more than 3,000 students in Mt. Pleasant, South Carolina, work together to design assignments and labs that engage students in learning. Their students are enrolled in the mathematics, science and engineering academy, one of four career-oriented academies for students in grades 10 through 12. The other academies cover arts and humanities; business and information systems; and health sciences, human and public services.

Students participate in many hands-on activities that increase their understanding of science. For example, they make “bottle fish” to support their study of classifications, habitats, adaptations and niches. Each student selects one fish to classify, makes a scale model from a discarded plastic drink bottle, and constructs a data sheet on the fish’s habitat, its place in the food chain, its economic significance and the effects of human actions.

In another project, students transform the amino acid sequence from a section of chicken protein into the amino acid sequence found in a partial strand of human hemoglobin.

All students are required to produce lab reports on the computer. These electronic reports include the purpose of the lab; basic information, including a description of the experiment and an hypothesis; materials used in the lab; the procedure; results, including data tables, graphs and qualitative observations; and a conclusion.

Teachers in all four academies identify yearlong themes, such as “Bridges to the Future” and “Aiming for Success,” to give purpose and direction to their instruction. They also design community-related assignments in all courses. For example, students in biotechnology engineering worked in groups to develop a plan for redesigning a local hospital in tandem with a local initiative to do just that. They interviewed hospital staff members from all departments, including physicians and custodians, to gather input before working on a design.

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## Senior Project Participation Is Perfect 100

The required senior project at **Randolph County Schools** in Elkins, West Virginia, has evolved such that every senior who made a presentation in 2007-2008 satisfactorily completed the assignment. The students received one-half credit each for their projects and were able to receive their diplomas on graduation day.

Completion hasn't always been 100 percent, admitted Senior Project Coordinator **Deborah Super**. “Over the years, we have had a few seniors who did not complete their projects successfully and were not allowed to participate in the graduation ceremony,” she said. Students who miss the deadline can attend a session after graduation where they can make up the requirement to receive a diploma.

The senior project at Randolph County Schools actually begins in the 11th grade when students select mentors and complete research papers with the help of their mentors and English/language arts teachers. “If students do not meet this expectation, they cannot take senior English,” Super said. “They have to repeat junior English or complete their research papers through the credit recovery program.”

Students spend at least 60 hours outside of class working on the senior project. They are expected to devote 20 hours to completing a research paper in their junior year and 40 hours to finishing the project and preparing a product that demonstrates what they have learned. However, many students spend more than 100 hours on their work. Students also develop a portfolio of essential materials in connection with the project and prepare an oral presentation that they deliver to a panel of three judges from the school and the community.

Since the senior project became a graduation requirement in 2002, it has improved each year as a result of input from faculty, administration, the community and students.

- Faculty training on how to evaluate the projects and products has increased the reliability of scoring.
- Community judges receive evaluation guidelines in advance of the presentation day. Expectations are clear to everyone — parents, students, teachers, administrators and community volunteers.

- The scoring rubrics for the research paper, the project, the product and the oral presentation have been revised periodically with input from every group involved in the senior project. At first, the concept of a “project” was vague; now it is clearly defined as “a series of related activities completed over a period of time.”
- The school instituted a policy that students must pass the project during the semester in which they take senior English to “walk” at the graduation ceremony. This policy eliminated the problem of students delaying their presentation until make-up day for no good reason. Now the make-up session is held *after* graduation.
- The senior project coordinator developed a new junior research paper handbook for special education students in self-contained English classes. These students have much more success in researching and writing an I-Search paper — a format that includes fact-finding forms, a learning evaluation and specific steps for writing an electronic version of a final paper, which is scored on a modified rubric. Special education teachers report that the process benefits their students to a much greater extent. (Special education students follow the same guidelines as regular students for the project portion of the process.)
- The research paper and presentation components of the senior project are correlated with state content standards and objectives for English/language arts and 21st-century skills. Although the senior project is a separate one-half credit for graduation, students also master content standards from the academic or career/technical area related to the senior project topic.

Not surprisingly, the tweaking that the school district has done through the years has resulted in some high-quality senior projects. One example is the Celtic play titled *The Glass Ghillie: A Cinderella Story* that one former student wrote. “It is still performed every year in March, and the student comes back each time,” Super said. “A quality product will last long after the presentation day.”

Since the senior project became a graduation requirement in 2002, it has improved each year as a result of input from faculty, administration, the community and students.

Another example is the student who refinished his school's theater stage by getting all materials donated and doing the work himself with his mentor's guidance. The project saved the school at least \$5,000. One student became the area's first Relay for Life junior chairman, while another student built a new school bus stop for a rural area.

Parents, students and teachers report these benefits from the senior project:

- Students engage in research and writing for a meaningful purpose. Students realize that their research papers will lead to projects and then to products. The choice of a topic leading to a successful project is crucial.
- Since implementing the policy that students cannot enter senior English without completing the research paper in the 11th grade (one-third of the final grade for the senior project), the district has recorded an increased number of students passing this component. Teachers report that students have a clearer idea of the importance of sequencing and a stronger understanding of the link between research and the project/product.
- Seniors have become more involved in local, state and global community service. Because so many students have completed outstanding community service projects, Randolph County's *Vision 2010* report included the recommendation that community leaders continue to support senior projects.
- Many students who never have been academically successful in the classroom are amazed to find that they can impress a panel of judges with their accomplishments.

- Students must apply 21st-century skills such as technology, critical thinking, communication and problem solving to complete their projects.
- Students develop interpersonal skills as they work with mentors and others. Although the projects must be individual efforts, students learn that no one works alone. Mentor relationships have resulted in employment and job or college references.
- Now that seniors must pass the senior project to participate in the graduation ceremony, the motivation to complete meaningful projects has definitely increased. In 2006 one school in the district had 37 students who did not pass the project. In 2007, after the policy linking the project with graduation went into effect, the same school had only three students who fell short. In 2008 every student passed on the first try.

One senior from a rural school summed up his senior project experience in his presentation by saying, "By doing my senior project, I learned that I can take the skills I learned in school and use them in the real world."

To download a copy of the 22-page Senior Project Handbook containing guidelines and forms for students to use in completing their projects, go to the Web site for Randolph County Schools at <http://boe.rand.k12.wv.us/>. Click on Schools, Randolph Technical Center, Jr. and Sr. Handbooks, My Files, and Senior Project Handbook.

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## Reading and Raking: Getting Ready for a Senior Project

Schools that require senior projects for graduation see a need for students in grades nine through 11 to sharpen their knowledge and skills before they tackle a challenging project in the 12th grade. **Tri-County Regional Vocational Technical High School** in Franklin, Massachusetts, has solved the lack-of-preparation problem by requiring underclassmen to conduct community service learning projects that incorporate research and technology as well as the reading, writing and presentation skills that students need in the classroom and in completing their senior projects.

Students may perform direct services that involve interaction by aiding and assisting teachers and coaches, serving meals to the homeless or visiting in nursing homes. They can also provide indirect services such as picking up litter, doing maintenance work for a nonprofit organization or sorting materials for a fund-raising event.

Under the direction of the social studies department, students submit a written proposal for a community service project. They keep logs of their activities, write about their experiences and create a PowerPoint presentation to describe what they have accomplished.

Because transportation can be difficult to arrange for younger students, the school allows freshmen to conduct their 10-hour community service projects on campus by assisting at parent-teacher nights, giving presentations to inspire other freshmen, volunteering in the homework center, and assisting the athletic director at sporting events. Sophomores may complete eight of their 15 hours at school, while juniors may spend half of their 20 hours in on-campus activities.

Teachers keep students on track with their projects by providing a timeline, a service contract outlining students' responsibilities and a parental agreement. Students also have rubrics, checklists and calendars to guide their service projects, which begin in September and conclude in April.

A committee of teachers, students, parents and representatives of business and industry is organized to oversee the projects. The committee works with social studies teachers to make sure students are getting the preparation they need to do a good job in their senior year.

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## Problem Solving Makes Classes More Interesting

**M**athematics, science and career/technical teachers in grades seven through 12 in Illinois are participating in professional development to help their students gain a better understanding of the types of problems they will be expected to solve in their chosen careers.

The project includes a summer institute, follow-up activities during the school year, high-quality materials and resources, and partnerships that bring teachers into direct contact with the daily operations and decision-making situations of business and industry. As a result, the teachers are creating hands-on, real-world learning opportunities to build students' critical-thinking and problem-solving skills and to make learning more interesting.

"Too many students leave high school without a basic understanding of math and science," according to **Frances Beauman**, director of the Illinois Career Technical Education Math and Science Partnership project. "The goal of the project is to improve the math and science skills of students by providing teachers with a better understanding of mathematics, science and engineering as it relates to industry."

Teachers in the project are given sample problems to solve that they can pass along to their students. One example is:

*"You are the operations manager at the Waxahachi, Texas, distribution center for a large drugstore chain. You serve the states of Texas, Arkansas, Oklahoma and Louisiana. You have candy to ship to sites in these states in time for the Halloween sales period. Last summer the temperatures were 105 to 110 degrees, and as a result many of the stores received melted candy. The vice president of operations has asked you to gather information, determine possible solutions, and decide how to avoid the problem this year."*

In tackling the dilemma, a group of teachers or students would develop a list of ideas, discuss the pros and cons of each idea, reach consensus on one idea, develop the idea into a report with details of how to accomplish the task and present the report to a "management team."

Teachers also learn how to work with business and industry partners to develop authentic problem-based scenarios in the schools' communities. During an appointment with a business leader, a teacher asks for an experienced manager or another professional-level employee to assist in the development of a scenario. The contact person will identify and/or develop information and materials, host and conduct a site visit for the teacher's students, and evaluate students' reports and presentations based on solving the problem. While visiting the company, the teacher observes the equipment and other resources being used and the major tasks being performed.

According to teachers, the project raises student achievement and awareness of what will be needed for success after graduation. Here are two testimonials:

- An automotive technology instructor at the Bloomington Area Career Center in Bloomington, Illinois, surveyed his students after using problem-based learning to reinforce mathematics instruction in his subject. Ninety-five percent of students said they believe mathematics plays an important role in automotive technology.
- A mathematics teacher at Morton High School in Cicero, Illinois, assigned a variety of technologies and asked her students to solve problems in groups, write reports and make class presentations. "Students were very engaged in the learning process," she said. "They will be able to retain and apply the information in future situations."

The Illinois Career Technical Education Math and Science Partnership is supported by a state grant and is aligned with state learning standards. Modules containing unit plans, lesson plans and instructional resources are available at [www.tdlmathscience.org](http://www.tdlmathscience.org).

**"The goal of the project is to improve the math and science skills of students by providing teachers with a better understanding of mathematics, science and engineering as it relates to industry."**

— **Frances Beauman**  
*Director  
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# Curriculum Project Integrates Academics Into Career/Tech

**Monroe Career & Technical Institute** (MCTI) in Bartonsville, Pennsylvania, enrolls 1,100 students in 25 career/technical (CT) programs. Students come from their home high schools to attend the institute on a half-day schedule.

For the past three years, MCTI has been involved in a major curriculum project to develop programs of study, also known as planned courses, for every CT program at the school. Each new program of study combines Pennsylvania's academic standards with skill competencies from the CT field of study.

When MCTI decided to retool its curriculum, it engaged an educational consulting firm, James Daniel & Associates, to provide a systematic way to integrate academic standards and technical skill competencies. The company's method — using a Web-based application available through [www.unitplanner.com](http://www.unitplanner.com) — offers a point-and-click approach to combining standards and competencies into one document. "The system requires teachers to consider the academic skills needed by students in their programs before developing modules of instruction," said **Dan Perna**, president of James Daniel & Associates. "It also compels teachers to consider how assessment will drive instruction."

The result of the new integrated curricula is that students will be expected to master academic skills along with CT tasks in each course. Each new program of study addresses a certain number of academic standards in reading, writing, listening and speaking; mathematics; and science. In the cosmetology program, for example, students will be expected to address a Pennsylvania academic standard such as: "Demonstrate fluency and comprehension in reading, i.e., read familiar materials aloud with accuracy; self-correct mistakes; use appropriate rhythm, flow, meter and pronunciation; read a variety of genres and types of text; and demonstrate comprehension."

During the first year of the curriculum project, CT instructors reviewed and updated the task lists for their programs according to industry standards. The programs' occupational advisory committees verified and approved the lists.

In the second year, MCTI's reading and mathematics coaches trained all CT instructors about state-level academic standards and how to incorporate the standards into the curriculum. After the training, the instructors identified the

reading, writing, listening and speaking; mathematics; science; and career-and-education work standards for each task required in a CT program.

Instructors wrote their curricula in the third year. Each program of study identifies the unit lesson description or objectives, tasks, safety requirements, academic standards, learning activities, resources and equipment, and evaluation of student performance. The evaluation section drives the learning activities required to achieve the program goal. The school produced a handbook to guide teachers through the developmental process. Teachers will develop individual learning guides for each task in Level 1 of each CT program in 2008-2009 and for each task in Levels 2 and 3 in 2009-2010.

Currently, instructors are combining the state standards into daily lessons, assignments, assessments and task instruction. One example would be a unit in the computer networking/security program. The unit requires students to understand and be able to perform the duties of a desktop support technician. They will not only need to know the computer concepts but will be expected to know the academic concepts that contribute to success in the computer field.

The new integrated programs of study serve as administrative documents and instructional guides for teachers and students. Current and future students, parents, district personnel and community leaders will be able to view the curricula on the school's Web site. The plan is to review and update the curricula annually.

"Our career/technical teachers are aware of the academic standards, have identified them in career/technical tasks that students are expected to perform, understand the connections between the standards and the tasks, and have begun planning lessons with the standards in mind," said **Carolyn Shegelski**, assistant director at MCTI.

**"Our career/technical teachers are aware of the academic standards, have identified them in career/technical tasks that students are expected to perform, understand the connections between the standards and the tasks, and have begun planning lessons with the standards in mind."**

**— Carolyn Shegelski**  
*Assistant Director*  
**MCTI**

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## Learning Summit Focuses on Raising Academic Achievement

**South Grand Prairie High School** in Grand Prairie, Texas, has a reputation for doing things in a big way. When this suburban school of more than 2,600 students received a grant to become part of the *HSTW* Enhanced Schools Network, every teacher was enlisted to help raise student achievement by increasing the amount of academic learning across the curriculum.

The focus was a two-week learning summit involving all teachers and students at the school. The cross-curricular emphasis on academic learning showed core teachers that they were not alone in efforts to improve test scores in reading, mathematics, science and social studies. Non-core teachers realized that they play an important role in the schoolwide effort to elevate academic expectations and achievement.

“Core teachers had been meeting weekly to review test results, discuss areas of concern and identify better methods of teaching certain skills,” said **Barbara Hagle**, art teacher and coordinator of academies, advisory and special initiatives. “It was time to involve everyone, not just the core teachers.”

Prior to the learning summit, academic teachers made presentations to elective-area teachers on the primary learning standards in each academic course. The objective was to find a common area of understanding and to design a teaching unit around that understanding. On a staff development day, elective teachers gathered in classrooms and became “students” while academic teachers taught five or six concepts that real students were having trouble learning. After elective teachers rotated through English, mathematics, science and history classrooms, each teacher chose one of the concepts.

Working together, teams of academic and CT teachers developed lessons and projects that students completed during the learning summit. The principal approved the projects and distributed them to the entire faculty. The projects were put on display in the school at the end of the summit for everyone to examine.

- A U. S. History teacher and a graphic arts teacher created a project in which graphic arts students identified and defined the major eras in the nation’s history from 1877 to the present. Students enjoyed designing detailed graphic time lines. One student said she learned more about that period of history during the two-week project in graphic arts than she had learned in history class. “The reason for the increased learning was that students learned in a different way and in a different class — and were very much a part of the learning process,” Hagle said.
- Art students researched and created sculptures and designs to represent insects and other biological subjects as well as characteristics of the periodic table of the elements so essential in studying chemistry.
- Media tech students created videos of students teaching federalism in a history class. They also recorded students conducting experiments to teach science concepts and science vocabulary.
- Art students improved their mathematics skills by participating in a scavenger hunt to find objects to measure. They also compared distance and size with perspective to master the use of a ruler in solving problems.

Teachers and school leaders learned several lessons during the event:

- Academic learning must be meaningful and relevant.
- Schoolwide efforts bring results.
- It is not difficult to teach across the curriculum.
- Teaching core concepts can be engaging to students.
- Students can be good teachers by practicing and demonstrating their knowledge.
- Project-based learning builds confidence.
- Students retain what they learn in project-based lessons.
- Learning occurs when students are challenged and teachers are held accountable.

The learning summit was so successful that the principal has approved plans to conduct a summit every six weeks instead of once a year.



Non-core teachers realized that they play an important role in the schoolwide effort to elevate academic expectations and achievement.

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## Virtual Program Builds Students' Business Savvy

Juniors and seniors in 66 “practice firms” at 53 high schools in the New York City public school system are learning skills and making connections that will give them a head start in further education and business careers. These students are enrolled in Virtual Enterprise (VE) courses based on a European model that New York school superintendents pioneered in the United States.

The program fills the needs of business-minded students for a rigorous, hands-on high school experience. It has also captured the approval of a long list of business leaders that lend expertise to the curriculum and welcome the chance to interact with a group of high-achieving, business-oriented young people.

An article in the May 22, 2006 issue of *BusinessWeek* magazine reported that the accounting firm of Deloitte & Touche had invested more than \$1 million in staff time into mentoring New York City high school students in the VE program. More than a dozen of those students had moved into paid high school internships at the firm, and many had stayed on after entering college. The firm considers the VE program to be “a valuable pipeline to an important pool of talent: smart, motivated teenagers,” the magazine reported.

Students take a double period (86 minutes) of VE for two consecutive school terms. “Combined with the computer courses and general business courses that students take earlier in their high school careers, the program amounts to a three-year commitment to learn how to operate a successful business,” said VE Associate Director **John Jastremski**.

In New York City, project-based learning is used in computer applications classes, where students study Word, Excel, Access and PowerPoint. Entrepreneurship, the second course in the VE sequence, introduces students to the topics that a student typically would study in a college-level introduction to business course. Students continue to develop their computer applications skills in the entrepreneurship course, which uses a curriculum developed by the National Business Education Association and aligned to the National Standards for Business Education and to the National Content Standards for Entrepreneurship Education, developed by the Consortium for Entrepreneurship Education.

Schools can choose to provide integrated economics instruction by using the Economics for the Virtual Enterprises curriculum, which was developed by Virtual Enterprises in collaboration with the Federal Reserve Bank of New York.

“Experience has shown that students are better able to comprehend some of the complex topics in economics, such as foreign currency, when the topics are connected to activities that are taking place in the Virtual Enterprise program,” Jastremski said.

Virtual Enterprise “companies” run the gamut from advertising to Web site design. Some of them focus on service and merchandising, although the products are virtual. The student-run businesses include Torque Enterprises (bicycles), A.C.T. (accounting, taxation and consulting), Virtual Chillers (beverages) and Virtually Protected Insurance (insurance agency).

Each company has a chief executive officer and a president.

Vice presidents head the five departments — Administration, which oversees company operations; Accounting, which handles all monetary transactions, including accounts receivable, accounts payable and the company banking system; Human Resources, which handles personnel issues, including the development of an employee manual of policies and procedures, the hiring and firing of employees, and employee evaluations; and Sales and Marketing, which plans and executes marketing, advertising and promotional strategies.

The Accounting and Human Resources departments manage the 401(k) retirement plans for employees.

Students perform a variety of tasks in operating the company, including doing business with VE firms at other schools. Where possible, students rotate through jobs and perform tasks in all departments.

They also participate in national and international trade fairs and a business plan competition — two capstone components of the program. The purpose of the capstone projects is to actualize the world of work, communications, technology and global business for the students.

In the business plan competition, students write a business plan to present to an audience and a panel of judges in a contest that takes place each spring in New York. Schools from across the nation enter the competition in which students vie for scholarships funded by Merrill Lynch. Students’ written plans and presentations are evaluated through use of a rubric developed by the U.S. Network of Virtual Enterprises. The evaluation is based on financial statements, marketing plan, break-even and SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis, presentation skills and responses to judges’ questions.

“Students in Virtual Enterprise learn in a way that allows them to improve the ability to handle information, make decisions, work alone and in groups, set up objectives and evaluate their progress.”

— John Jastremski  
Associate Director  
Virtual Enterprises International

Students participating in the trade fairs have opportunities to engage in face-to-face commerce with other students. These fairs are held in various locations in the nation. More than 3,000 participants from 11 countries and 11 states attended the New York trade fair in April 2008. Students set up booths and competed in booth design, best catalog and best sales pitch.

“Students in Virtual Enterprise learn in a way that allows them to improve the ability to handle information, make decisions, work alone and in groups, set up objectives and evaluate their progress,” Jastremski said. “In other words, they gain the knowledge and skills to be life-long learners.”

The primary responsibility of a teacher in a Virtual Enterprise course is to guide and direct student learning, rather than to deliver a prescribed lesson. Teachers work closely with business mentors to ensure that students benefit from authentic learning.

Corporate business partners adopt a school and provide direct assistance to VE students. The roles of business partners include:

- scheduling visits to their businesses for students to see firsthand what real employees are expected to do.
- providing internships for students at the company or subsidizing internships at community-based not-for-profit organizations.
- helping students design trade fair booths and providing display materials and sample products for the booths.
- providing externships for teachers to learn about the inner workings of a business.

The September 2007 study, *When the Virtual Becomes Real: Student Learning in the VE Program* (Hughes & Wang Golann, Institute on Education and the Economy, Teachers College, Columbia University), identified the following student outcomes:

- VE had a largely positive effect on students’ career preparation. Students acquired a variety of workplace skills, including office skills, computer skills, problem-solving skills and interpersonal skills. The vast majority (84 percent) of survey respondents indicated that they could use the skills learned in VE for future employment. This suggests that VE provides an education that seems relevant to students’ futures and helps students make connections between school and work.

- VE fosters critical thinking. Instead of being recipients of information, students play active roles in their companies and make decisions that will benefit the businesses. Almost three-fourths of students indicated that VE helped them develop problem-solving skills.
- VE motivates students to achieve at a higher level. Fifty-eight percent of students found that what they learned in VE was more challenging than what they learned in other classes. Setting higher expectations for students and showing them the relevance of education can be powerful motivating forces. Sixty-eight percent of students said motivation was higher in VE than in other courses. Fifty-three percent of students said VE motivated them to do better in other classes.
- VE participation helped the majority of students in the survey feel more prepared for college. Sixty-six percent of students said VE improved their confidence about being prepared to do college-level studies. Sixty-three percent of students said VE made them believe that college was a realistic option. Forty-six percent of students said their VE teachers helped them with college planning — an important finding in light of teachers’ workloads and the fact that school guidance counselors generally handle this responsibility. Sixty-seven percent of students indicated that VE helped them focus on what they wanted to study in college.

New York City student data revealed that attendance for VE students is higher than overall school attendance (87 percent versus 81 percent). Performance on the VE assessment test showed a raw score improvement of 13.4 percent in pre- and post-test scores.

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