

HARMONY PUBLIC SCHOOLS TEXAS



PASCO

CASE STUDY

HARMONY PUBLIC SCHOOLS TEXAS

Schools

54 schools
33,500 students
24% limited English proficient
61% economically disadvantaged
<https://www.harmonytx.org>

Challenges

Creating a new project-based learning (PBL) model from the ground up
Providing PBL curriculum materials and resources for teachers
Equipping high school physics labs with tools for PBL

Solutions

PASCO digital sensors
SPARKvue® software
PASCO Capstone™ software

Implementation

Grades 9-12
Physics, AP®physics, dual credit physics

Results

In 2015-2016 and 2016-2017, all Harmony schools met or exceeded state academic standards set by the Texas Education Agency.
100 percent college acceptance rate for Harmony students.
58 percent of Harmony graduates choose STEM majors in college.
100 percent of students passed the state's 2013 End-of-Course test in physics.
Invitations for students to present at local, regional, state, national, and international conferences



Levent Sakar, M.Ed.
STEM/PBL Activity Coordinator
Curriculum Director, Physics

Introduction

Harmony Public Schools is a system of high-performing, K-12 college-preparatory charter schools that focus on science, technology, engineering, and math (STEM). Harmony has a very engaged, hands-on approach to education, where students are directly involved in designing, building, experimenting, and demonstrating their investigations and projects in a PBL environment.

In late 2012, Harmony Public Schools was awarded a \$30 million Race To The Top District grant funded by the U.S. Department of Education. With the grant, Harmony set out to develop a STEM curriculum that incorporates project-based learning (PBL) to increase students' STEM knowledge and interest, and balance student-centered teaching with state and national standards. Called "STEM Students on the Stage (SOS)[™]," the personalized PBL model is a rigorous, interdisciplinary, standards-focused method of STEM education that encourages students to engage and share their STEM knowledge, investigations, and projects.

Upon receiving the grant, Harmony partnered with PASCO Scientific to strengthen its physics program and use PASCO sensors and software in all 25 high schools. "We mostly use PASCO equipment in our physics program," said Levent Sakar, the STEM/PBL activity coordinator and physics curriculum director for Harmony Public Schools. "I have worked in different school systems in several different countries and have had the opportunity to compare physics equipment and technology from around the world, and we chose PASCO solutions for our high school physics labs. PASCO sensors and software are so easy to use that our teachers and students were able to jump in and get started with them right away."

Harmony also worked closely with PASCO to develop and integrate physics PBL modules into its STEM program. "In a traditional PBL model, teachers are expected to design the PBL projects by putting together all of the instructional materials on their own. Instead, our PBL design teams, composed of the teacher leaders, prepared student and teacher resources in collaboration with the PASCO curriculum team. We designed our own essential investigation handouts, year-long project handouts, teacher guides, rubrics, and assessments with PASCO," said Sakar.



Deepening student understanding and engagement

In Harmony Public Schools – which has schools in all major Texas metropolitan areas including Houston, Dallas, Austin, San Antonio, and El Paso – students use the PASCO sensors for accurate, real-time data collection. With the ability to take over 80 measurements, the rugged, reliable sensors combine advanced technology with plug-and-play usability for easy use in and out of the classroom. Students also use SPARKvue® software and PASCO Capstone™ software with the sensors for real-time quantitative measurement and analysis.

“Harmony uses PBL as a major lever to personalize education and engage students in deeper learning. It allows students to demonstrate mastery of the curriculum content and hone in on their interpersonal skills, both of which are critical for college and career success,” said Sakar. “With PASCO sensors and software, students can engage in hands-on learning, master physics concepts and principles, and share them with others in their communities. The more they share, the deeper they engage and become natural STEM advocates.”

“When I started teaching, I didn’t have a lot of experience with sensors,” said Bilal Sengez. Sengez teaches AP® physics, pre-AP® physics, and physics, and is the science department chair at the Harmony School of Advancement in Houston. He also serves as the system-wide subject course leader to prepare AP® Physics curriculum. “During our first experiment with the PASCO Motion Sensor and SPARKvue, I saw how easy the sensors were to use and how accurate the data was. Now I try to use PASCO sensors in all of our experiments.”

“In fact, he uses PASCO solutions so much that everyone now calls him PASCO Bilal,” added Sakar.

Now Sengez primarily uses PASCO Capstone software to provide more advanced capabilities for high level physics applications. “I like to let students explore Capstone on their own and figure out how the different tools work, so they can see what options they have when they do their own investigations,” he said. “When we use Capstone with PASCO sensors, such as the Voltage/ Current Sensor, students can see changes they normally wouldn’t be able to see, which helps them visualize and understand what’s happening. One thing

we really enjoy in Capstone is the video feature, which allows students to synchronize their data collection with video. They can then replay their data collection at slow, normal, or fast speed, or stop the video at any point to see how their data is reflected in the image.”

Sengez also likes to use the video analysis feature of Capstone software. “One of the reasons that I love video analysis in Capstone is its simplicity. You just click on the object and the video goes frame by frame. Once you select your data points, you are able to draw both linear and rotational quantities graphs in both ‘x’ and ‘y’ axes. That Capstone feature allows you to do the experiments and analysis without sensors,” he said.

In addition, Sengez enjoys using the physics PBL handouts that were created by Harmony’s curriculum writers and PASCO. “The PBL handouts make my job easier because the investigations enable students to explore and learn on their own. There are also analysis questions at the end, which help me assess what they’ve learned so I can address any points they didn’t understand,” he said.

Sengez also assigns the PBL handouts as homework. “When students do an investigation at home, they’re well prepared for my lecture the next day,” he said.

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Bilal Sengez,
System Course Leader,
AP Physics

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Levent Sakar, M.Ed
STEM/PBL Activity
Coordinator
Curriculum Director, Physics

Through our PBL model and our use of PASCO sensors and software in our physics program, students are building the skills they need to succeed in STEM majors in college and STEM careers. Even if students choose not to pursue STEM beyond high school, they're building 21st century skills they can use anywhere. Whichever path our students choose, they're well prepared to chart a course to the future.

Levent Sakar, M.Ed

Over the last four years, I've seen improvements in the format of students' experiments because of their work with PASCO sensors and software. "I've shown local colleges what we're doing in physics with PBL and PASCO, and they want to show this model to other school districts so their students will be as well-prepared as ours."

Fatih Gozuacik, M.Ed., M.S., MPhys
System Course Leader,
Dual Credit Physics



Making the invisible visible

Fatih Gozuacik, an AP[®] physics and dual credit physics instructor at Harmony Science Academy Brownsville, uses PASCO sensors, SPARKvue, and PASCO Capstone software in all of his physics classes. Gozuacik is also a physics curriculum writer and is in charge of designing instructional materials for the dual credit physics program, which allows students to enroll in college courses and earn credit for both high school and college.

At the beginning of the year, Gozuacik has students conduct an investigation with the PASCO Motion Sensor to help them discover the relationship between position, velocity, and acceleration. "When the sample rate changes, students can hear it. This is vital for them to understand the logic behind the Motion Sensor. If they aren't able to hear the clicks, they may get the data but not understand it," he said.

Gozuacik estimates that each class uses PASCO sensors and Capstone software for at least 25 to 30 experiments throughout the school year.

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colleges what we're doing in physics with PBL and PASCO, and they want to show this model to other school districts so their students will be as well-prepared as ours are."

Increasing student ownership in learning

In grades 6-12, all Harmony students are expected to do a year-long STEM/PBL project. Many high school students choose to use PASCO sensors and software for their projects, such as videos.

"Harmony students have made thousands of STEM videos and posted them on their YouTube channels. If you search 'Harmony STEM' or 'STEM SOS,' you will be able to see these videos. This not only shows that students are engaged but also that they've taken ownership of their learning. PASCO is a part of many of these videos, which shows how much students enjoy working on the sensors and software," said Sakar. "Our teachers also enjoy posting projects that incorporate PASCO solutions on social media, which inspires other teachers within our large network of schools and others around the nation."

Sengez, for example, has posted a number of video tutorials, including a tutorial for an impulse momentum relation investigation (<https://youtu.be/jgMYvmdwAGI>), in

which he uses PASCO Force and Motion sensors and Capstone software.

STEM Students on the Stage

As part of the STEM SOS Model, students are required to share their knowledge. They learn to give public presentations in front of classrooms, at the Harmony Science and Engineering Fair, and at local, regional, state, national, and international competitions and conferences.

At the annual Texas STEM (T-STEM) conference, for example, Sengez's students led a presentation about Harmony's PBL model, and they presented a project on Bernoulli's principle, Pascal's Law, and Boyle's Law using the PASCO Pressure Sensor. At regional T-STEM conferences in 2016 and 2017, Gozuacik's students presented a project on "Technology Applications in Physics Class" using the PASCO Force and Motion sensors. To inspire other educators with the STEM SOS Model's "Share & Shine" approach, Gozuacik also presented his e-portfolio including (experiments and activities from his classes) at the American Association of Physics Teachers annual physics conferences in 2016 and 2017.



In 2015, MIT invited Harmony students to a Plasma Science Expo in Louisiana. "We were the only high school there. My students presented their projects, many of which used PASCO sensors. It was a great experience for all of us," said Sengez. "Being invited to present at these conferences shows students that the work they're doing is very important, and it's good for them to see college students doing the same projects we do in class. These opportunities also give students a chance to meet and talk with college professors, which helps them plan for their future."

I. Romero, one of the student presenters at the expo, said, "Being in a place with so many college professors and graduates helped me understand the applications of classwork and narrow down which field I wanted to explore. On one of these trips, I met a college professor from the university I ended up attending who offered me a volunteer position and eventually a job in the field of nuclear fusion at the only university reactor in the country! I will never forget the experience."

Gozuacik recently received feedback from a few Harmony Science Academy Brownsville alumni who participated in the STEM SOS Model and are now in STEM fields. An alumna who is majoring in biochemistry at St. Mary's University said, "My chemistry professor is impressed with my lab skills." An alumnus majoring in aerospace engineering at Texas A&M University said, "We are just doing the same experiments we did in high school; I feel so comfortable while others struggle a lot!" An alumna majoring in mechanical engineering at the University of Texas at San Antonio said, "I feel so easygoing with my mechanics lab and physics class because of all the similar projects I did at Harmony."

2013 State of Texas Assessments of Academic Readiness (STAAR) End-of-Course Exam in Physics

Texas Statewide Passing Rate	Harmony Passing Rate	Texas Statewide Advanced Rate	Harmony Commended/Advanced Rate
81.8%	100%	20%	58.06%

Improving student performance in physics

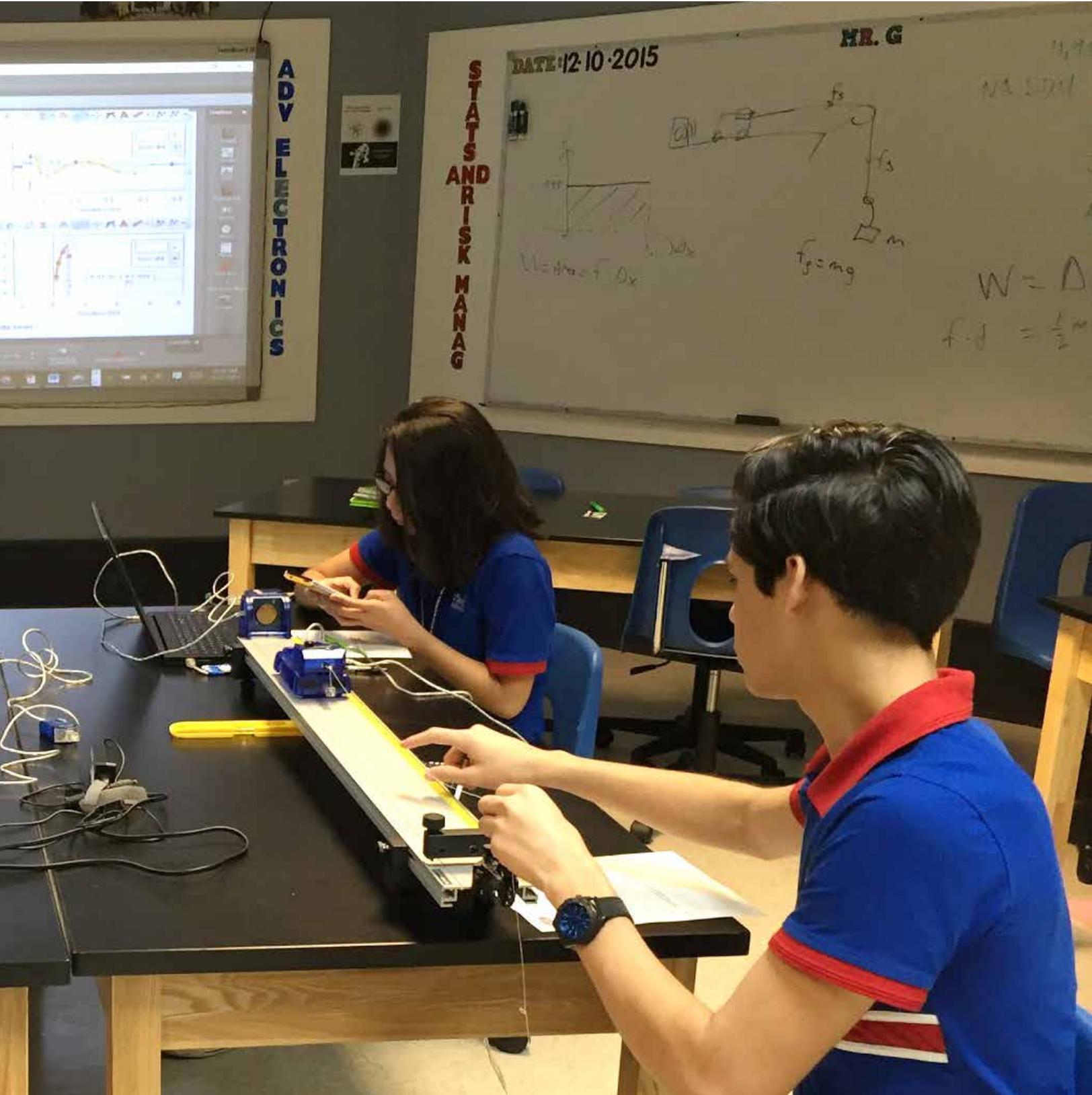
“Through our PBL model, we aim to equip students with 21st century skills that are essential in college, in the workplace, and in life. Integrating technology into their work, collaborating in pairs and teams, publicly presenting their work, using digital platforms and social media to share and market their projects – all of this is part of their education to prepare them for college and careers, and PASCO is a part of all of it,” said Sakar.

Harmony’s focus on STEM courses and the personalized PBL model are having a positive impact on student learning and achievement on state tests. In 2015-2016 and 2016-2017,

all Harmony schools met or exceeded state academic standards set by the Texas Education Agency (TEA). And 2013, on the state’s End-of-Course (EOC) assessment in physics, 100 percent of Harmony students passed, compared to the Texas statewide passing rate of 81.8 percent.

“Our success is due in part to students’ work on STEM SOS PBL projects using PASCO sensors and software,” said Sakar. “All of our students passed the EOC exam in physics in 2013, and 60 percent of our students scored at the advanced level.”

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Increasing the percentage of graduates choosing STEM majors

With a college acceptance rate of 100 percent, Harmony Public Schools has earned a well deserved reputation for providing a high-quality education. In addition, thanks to its powerful PBL approach to personalized STEM education, the number of Harmony graduates choosing STEM majors in college increased from 19 percent in 2010 to 60 percent in 2016.

“We want every student to be a STEM advocate and a problem solver by developing 21st century skills,” said Sakar. “Through our PBL model and our use of PASCO sensors and software in our physics program, students are building the skills they need to succeed in STEM majors in college and in STEM careers. Even if students don’t pursue STEM beyond high school, they’re building 21st century skills they can use anywhere. Whichever path our students choose, they’re well prepared to chart a course to the future.”

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