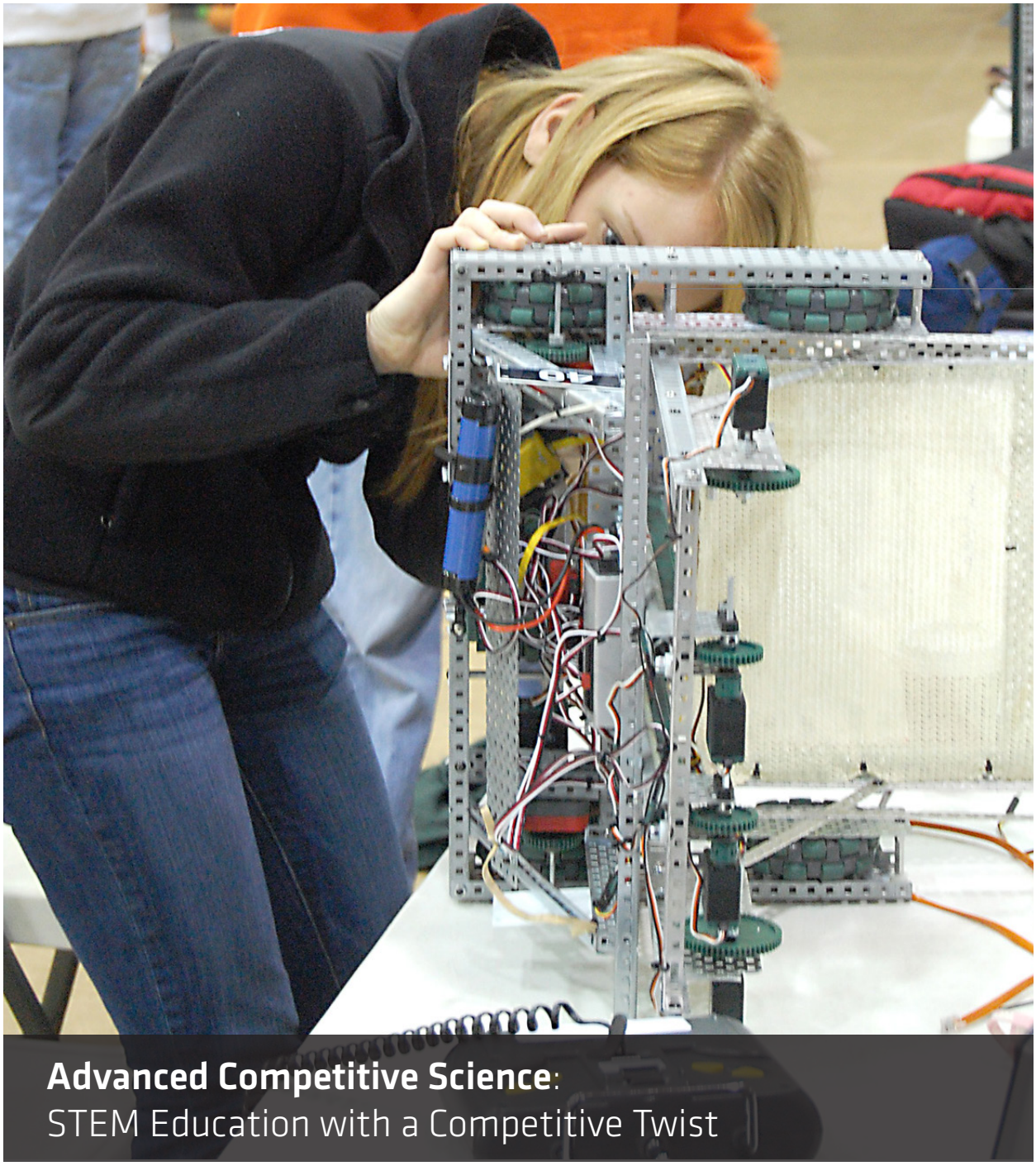
CASE STUDY

TRINITY HIGH SCHOOL



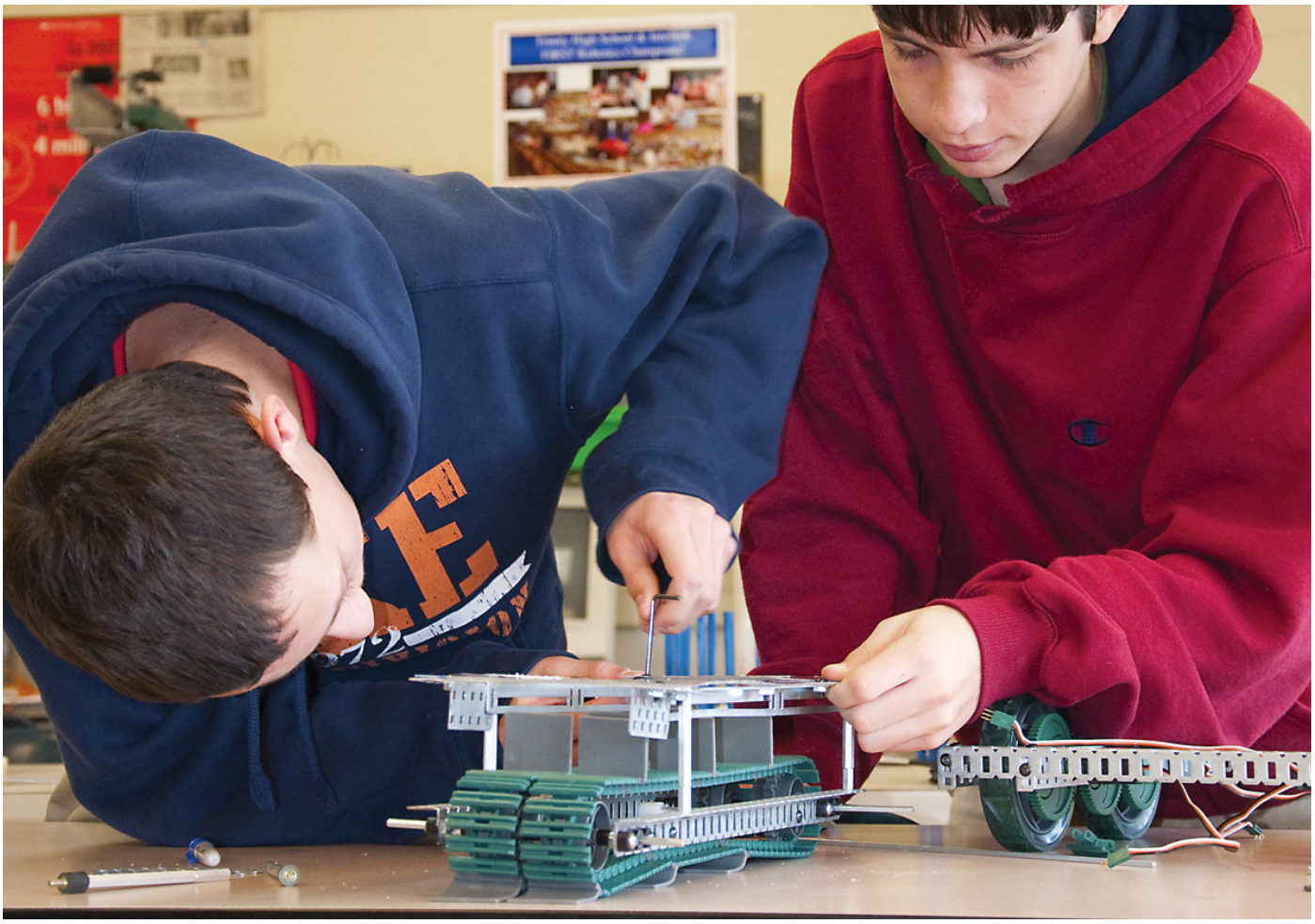
Advanced Competitive Science:
STEM Education with a Competitive Twist

INSPIRING STUDENT ACHIEVEMENTS

intelitek

TRINITY HIGH SCHOOL

Trinity High School in Manchester, NH, adds competitive robotics to an advanced science program delivering excellent results for student engagement.



Joe Pouliot has found the secret to engaging students in robotics engineering. As the science teacher at Trinity High School in Manchester, NH, Pouliot introduced Advanced Competitive Science (ACS) in 2004 and since then the course has become the hottest class at the school. More than a traditional STEM course, ACS harnesses the excitement of robotics competitions to promote student involvement.

Advanced Competitive Science is a two year course that teaches robotics engineering using project-based learning. The course can be taken as an exploratory course in robotics or as a launching pad for engineering majors. Making use of the two-year Robotics Engineering Curriculum™ (REC) offered by intelitek, inc., ACS covers advanced physics, math and engineering topics as it teaches robotics from the basics to advanced programming and design.

In addition, the class is fully engaged in a vigorous schedule of robotics competitions throughout the year including VEX™ Robotics Challenge (VRC), FIRST® Robotics Competition (FRC), miniFRC, and Savage Soccer at Worcester Polytechnic Institute (WPI).

"We have competitions going on all year, with overlapping schedules, so the kids never get bored in this class!" says Pouliot.

THE COMPETITIVE ADVANTAGE

Pouliot views competitions as the ultimate project-based learning format. Each year the competitions present a new design challenge. Each student can develop an individual solution, build their own robot and test their ideas. The potential to compete and win ensures students view their efforts as relevant. The ability to incorporate their own design solutions encourages students to take ownership of their ideas. Thus, competitions add a level of engagement that is often hard to achieve in a traditional classroom setting.

"That's the non-traditional part of it – we're not syllabus-bound," explains Pouliot. "We have a competition and we say: 'Alright, let's stop. Let's build robots.' That's the immersion method: throwing the kid into the deep end of the pool and saying: 'You have to build a robot that does three things – some sort of lift mechanism, some sort of arm – things they probably won't get to till later in a traditional class."

The real test comes during the competitions when students put their designs up against other robots.

"Competing in-house is one thing - getting out there, competing against a bigger group of teams makes it more meaningful," says Pouliot.

Advanced Competitive Science evolved from an effort to teach C programming for robotic control. Programming was often the least attractive aspect of robotics for many students. After working with various packages such as Lego Mindstorms® and Not Quite C, Pouliot began using intelitek's REC, which combined the VEX robotics platform with easyC® programming software. This combination proved to be a winner.

"With easyC, students took to programming like it was second nature!" says Pouliot. "REC brings it all together. Students get the hands on experience building a BaseBot out of VEX components and this is great preparation for the VEX competitions. VRC, miniFRC and Savage Soccer all use Vex, then if kids want to move on to more robust robots, there's FRC."

In 2005 Trinity High was selected as one of 50 teams to compete in the debut year of the FIRST® VEX Challenge (FVC). Pouliot decided to form an all-girl team to run the project. This team finished as a quarterfinalist in the FVC competition, and from that point on a new avenue was opened for involvement in competitive robotics, especially for girls.

"Everyone wanted to be on the team. Even the boys offered to wear skirts to be a part of it," says Pouliot.

The cost-effectiveness of VEX and REC allowed more students to explore engineering, physics and math in a project-based learning mode. With a grant covering start-up costs, a $500 per year budget from the school, and their own fundraising efforts, Pouliot's ACS classes have been able to field competitive teams in multiple competitions each year.

HELPING STUDENTS PUSH THE ENVELOPE

Team mentor Dan Larochelle is impressed at how the competitions bring out the best in the students: "It's amazing how much time the kids put into these designs. They will own their design and keep changing it until it they can make it work. And it goes way beyond the classroom. Once you get them into the first couple competitions, you whet their appetite and they want more. They see that their idea is pretty good but with just a little bit more work they can do great things. And then they are staying after school, asking for help programming, putting in extra work."

"Once you get them into the first couple competitions, you whet their appetite and they want more. "

DAN LAROCHELLE , VRC TEAM MENTOR

Trinity High School's all-girl team

"This couldn't have happened with traditional classroom-only instruction, The trial-by-fire nature of the competitions helps kids see what they can achieve. It makes them want to push the envelope

JOE POULIOT,
ADVANCED COMPETITIVE SCIENCE INSTRUCTOR

An exceptional example of this type of student development came in the 2008 Savage Soccer competition at WPI.

Simone Veillette was a student in Pouliot's class who was not overly enthused about her robot's design. In fact, she was convinced that it would have no chance at the competition, so she stayed home on competition day while the team took her robot to compete.

"We build this robot and she doesn't think it's any good," explains Pouliot, "and it goes to Savage Soccer and it just kills everyone because it can hold like 40 ping pong balls and dump them all into the goal at once. Kids were coming by and taking pictures and copying her design. And, the thing is, she didn't even go because she thought her robot would stink!"

Simone's robot won the Savage soccer competition. This surprise success opened Simone's eyes to her own potential and confirmed the validity of her design ideas. Now she competes as a senior with a new level of confidence.

"Now she's into it, she's building stuff," Pouliot observes.

For 'Clean Sweep', the 2009 VRC competition, Simone designed another VEX robot and won again.

"This couldn't have happened with traditional classroom-only instruction," Pouliot says. "The trial-by-fire nature of the competitions helps kids see what they can achieve. It makes them want to push the envelope."

THINKING OUTSIDE THE BOX

Competitions also encourage students to explore outside-the-box solutions. Student Nate McCormack demonstrated the effectiveness of that approach with a robot design that turned heads at the 2009 VEX Robotics World Championship in Dallas, Texas.

"Last year we qualified four teams to go to the World VEX Championship. There was no way we could afford to take four teams. With the expense and logistics, it just wasn't going to happen," says Larochelle.

Pouliot decided to use performance in the VRC Skills Competitions as the qualifier. In the VRC Skills Competitions, one robot scores points while operating alone on the playing field unhindered by other robots. The challenge for 2009 was to score by picking up blocks on the playing field and placing them in eight goals positioned around the perimeter with a 60-second time limit. The robot scored 5 points for each goal owned, and 1 point for each block placed.

"A lot of our kids were scoring 40 to 42 points in the skills competitions. We told them if they wanted to go [to the World Championship], they had to get 48 points – one block in all eight goals."

The 48-point criteria presented a design problem since the typical tank treads used to pick up the blocks could only carry seven blocks at a time. In order to score 48 points the robot would need to place eight blocks, but returning to the field to pick up an extra block within the 60-second limit was challenging.

To overcome this challenge, Nate McCormack brainstormed a design that would allow his robot to pick up and store more than seven blocks. His concept was to imitate the operation of a Gatling gun by pushing the blocks into a magazine wound around a central drum. He sketched out his idea on graph paper and presented it to Pouliot.

"It looked great on paper!" says Pouliot. "So we said: 'Alright, you can have all the parts you want. Go make it.'"

Nate worked on his prototype for a month, and found he could store ten blocks.

"Once he showed us his prototype we realized the potential of this design," says Larochelle. "He was approaching this problem from an angle no one else had tried, and the VEX platform allowed him to fully test out and demonstrate the idea."

Through the design process, Nate perfected the mechanism to index the magazine and aim the blocks for scoring. The final design resembled the snail on SpongeBob SquarePants, so Nate dubbed his robot "Gary" and went to the VEX Robotics World Championship. At the competition Gary ranked 13th out of 125 teams.

"All the robots at the competition looked the same, used the same core design – using tank treads," Larochelle noted. "But [Gary] was unique – it was the only one that looked anything like it. People came up to it and said: 'Wow – what is this?'"

"They'd say: 'It's a Ferris wheel!'" adds Pouliot. "We'd say: 'No, it's Gary.'"

"Even the chief designer from IFI who makes all the VEX mechanical components just looked at it and said 'How did you do that?'" recalls Larochelle. "Even he couldn't imagine something like that could come out of VEX. Which is pretty cool."

Gary also got the attention of the VRC awards judges, who presented Nate with the "Innovate Award", which recognizes one robot design that demonstrates the most ingenious and innovative piece of engineering.

SUCCESS BREEDS SUCCESS

"Making robotics competitions a part of ACS has fueled the success of the program," says Pouliot. "What started out as a seasonal game has become a year round endeavor. Now we field multiple teams each year and we have an all-girl FVC team who has won design awards and several championships. Kids are drawn to the school just for our robotics program! One in ten of our attendees is on the team."

While placing well at competitions and achieving awards are marks of a winning program, Pouliot believes real success is measured by something even more important - student success after graduation from the course.

"Many of our students go on to major in engineering, often at WPI, Clarkson and RPI. We've also sent our first grad to MIT. These students have a head start thanks to the experiences they've had in the competitions. They never forget it."

Simone adjusting her robot at competition

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