

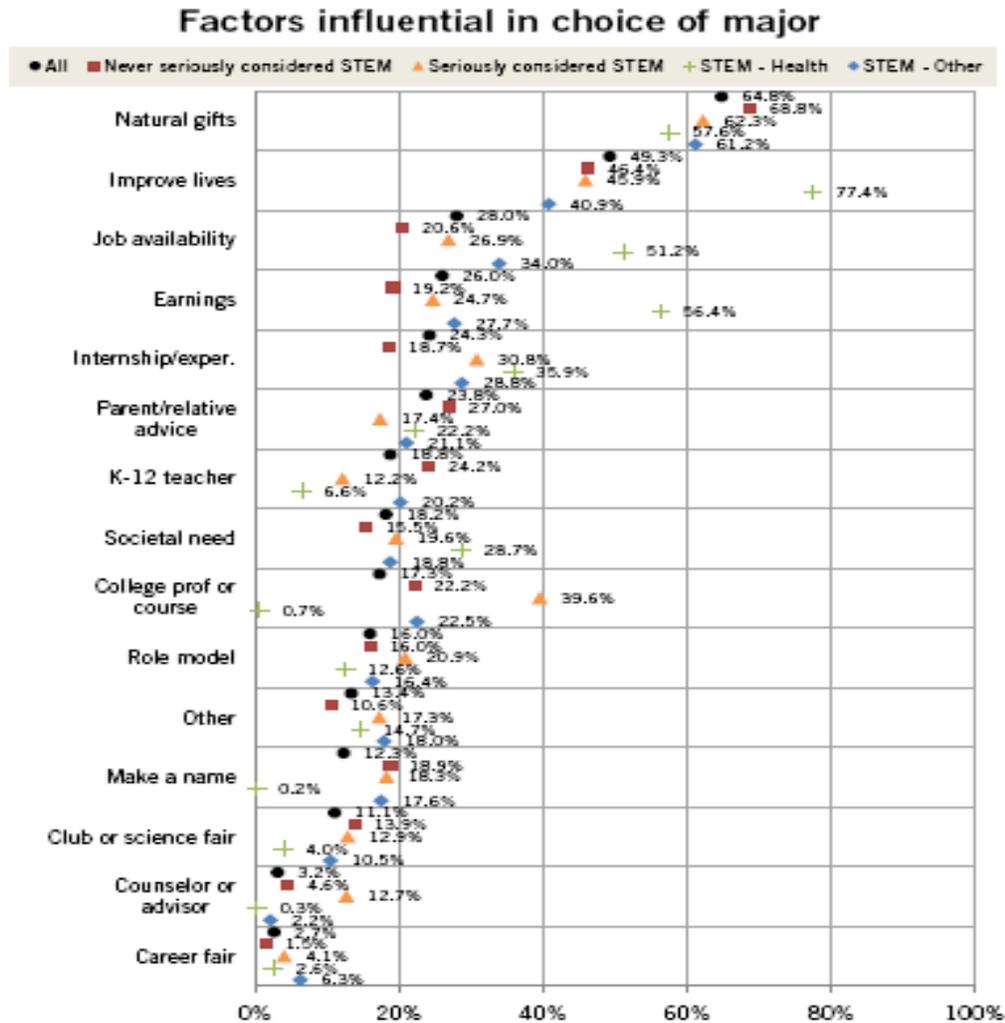


The Role of an Engineering College in Integrated K-12 STEM Outreach Efforts

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Numerous studies and publications have established the need to expand the number of students pursuing science, technology, engineering and math (STEM) undergraduate and graduate degrees in the United States. The need for professionals in these fields continues to increase, even as the portion of college-bound students interested in these fields stagnates—or, in the case of engineering and computing, slowly erodes.

National and, more recently, regional studies have identified the influences and experiences that affect the choices students make in regard to field of study in college and career path. In a recent regional study, the factors identified as affecting student choice included natural gifts, life improvements, job opportunities, earnings, internships, family advice, a K-12 teacher, social need, role models, club or science fair, high-school counselor and career fairs (see the table below).



Source: Cultivating STEM, "Why West Michigan college students select majors in science, technology, engineering and mathematics," Center for Social Research, Calvin College, 2008.



Note that among the results, only natural gifts and life improvements were mentioned by more than 50% of the survey participants. All other factors—largely those that can be affected by outreach and intervention—were mentioned by just 5-30% of the students.

One strong conclusion that can be drawn is that while outreach efforts certainly have an impact on student attitudes, there is no silver bullet. Rather, students (and their families) who have repeated exposure to STEM fields are most likely to pursue these disciplines.

Integrated outreach

Grand Valley State University (GVSU) is located in the greater Grand Rapids/Muskegon/Holland Michigan metropolitan area, the second largest metropolitan area in Michigan. In the late 1950s, this was the largest metropolitan area in the United States that was not served by a local public university. GVSU was established through an effort by the local community that petitioned the state of Michigan and raised funds to purchase the initial university property. This private/public partnership launched a close relationship between the university and the community that continues to this day. The university is now the largest comprehensive university in the Midwest with an enrollment of more than 24,400 students.

Similarly, in the mid 1980s, the school of engineering was created through an initiative driven by local industry leaders. The academic programs, facilities and integrated cooperative education program for all engineering students were developed by a team of faculty and engineers from the local community. The school evolved into the Padnos College of Engineering and Computing (www.gvsu.edu/pcec). With an enrollment of more than 1,200, it offers a variety of bachelor's and master's programs. The close relationship that initiated the engineering programs has grown into a true partnership to support local industry and the community.

As a comprehensive university, GVSU takes its broad mission very seriously. Thus, faculty are supported in and rewarded for their activities in the areas of teaching, scholarship and service. While teaching will always be their primary mission, faculty must be active in all three areas and are truly supported in service activities and scholarship. Many faculty members focus their efforts in service and the scholarship of service. Supporting K-12 STEM education in western Michigan has become a major element of the school's service to the community.



Figure 1 STEPs participants engage in team-building exercises, such as rock climbing.



One of the vehicles for university and community partnership in this area is the Regional Math and Science Center (RMSC) based at GVSU (www.gvsu.edu/rmsc). This long-standing center is one of 33 centers distributed throughout Michigan with the mission of improving K–12 math and science education. This organization offers a variety of programs and has been one of the most significant partners with the Padnos College of Engineering and Computing's outreach efforts.

Integrated outreach programs, partnerships

The outreach programs Padnos College supports began through faculty and staff involvement in RMSC's programs. As Padnos College considered the addition of targeted programs, administrators were able to build on RMSC's experience. In particular, three fundamental principles were established:

1. Developing interest in STEM fields must begin with students and their families before they make decisions on courses in middle and high school.
2. Creating a pipeline of activities to offer students throughout their K-12 education via a variety of formats is critical. Students must have the opportunity to be mailed in multiple programs rather than isolated, single-touch activities.
3. Growing partnerships is essential to maximize the benefit to the community. No single organization has the resources and passion to offer the variety of programs that are needed within the community.

Following this philosophy, Padnos College continued its participation in existing programs and began to develop its outreach activities at the late-elementary and middle-school levels. This was later expanded to include programs at the elementary and high-school levels. This expansion led to the addition of an outreach coordinator position within the student services office.

The programs currently supported by Padnos College include:

Program name	Student level	Focus/type	Primary partner(s)	Involvement
FIRST Lego League	Elementary	Robotics competition	FIRST	Coaches, judges, speakers, fundraising
If You Build It	Upper elementary	Summer camp Design and build	Grand Rapids Public Museum	Design contest, robotics, CAD, CNC and bridge competition activities
Sibley Elementary School science and math partnership	5th grade	Science and math: Hands-on curriculum enhancement	Grand Rapids Public Schools	Curriculum, teacher and student coaching, use of lab facilities
A World in Motion	Elementary	Curriculum module offerings	SAE	Faculty and staff offering modules in schools
Thinking Big and Building Small	Grades 3–12 and general public	Hands-on engineering activities	Grand Rapids Public Museum	Robotics, electronics and bridge construction activities



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STEPS	7th grade	Summer camp for girls (aviation theme)	RMSC, SME, Alcoa, NASA	Complete offering of program
Get-With-the-Program	8th grade	Summer camp for girls (programming theme)	NASA	Complete offering of program
MathCounts	Middle school	Math competition	MSPE	Facilities, speakers and scholarship
Science Olympiad	Middle and high school	Science competition	Support RMSC which organizes	Event coordinators and coaches
Junior Achievement Reverse Job Shadow Program	Middle and high school	Job shadowing	Junior Achievement	Engineering and career presentations
Project Days	Middle and high school	Display of GVSU student projects for local middle and high school students	Regional K-12 systems	Organize poster sessions, logistics, hosting and funding
Career Presentations	Middle and high school	Presentations at schools	Regional K-12 systems	Presentations and GVSU tours
Electrathon	High school	Electric car competition	Electrathon America	Workshops, judging coordinator, judges
FIRST Robotics	High school	Robotics competition	FIRST	Host events, support organizing team, facilities, fundraising, clerical support and scholarship
GRAPCEP	High school	Engineering and health high school	Grand Rapids Public School	Curriculum development, fund raising, internships, teacher and student coaching

Program highlights

The variety of programs and the levels at which they are offered are intended to provide K-12 students and their families the opportunities to engage in the STEM disciplines throughout each student's K-12 career. One of our most visible and long-term efforts is the science, technology and engineering preview summer (STEPS) program developed by the Society of Manufacturing Engineers (www.gvsu.edu/steps).

In 2002, SME approached GVSU and the school became the first site to offer the program in Michigan. This program uses an aviation theme to provide female students a week-long exposure to STEM fields in a fun, hands-on environment during the summer between the sixth and seventh grades.

In the STEPS program, the students build large remote control airplanes as a vehicle to introduce them to a variety of technical, career exploration and self-esteem building activities. The activities include:

- Courses such as computer-aided design, computer numerical-controlled machining, and aerodynamics and center of gravity.
- Web-page design, airplane construction and process planning.



- Flights in-light airplanes, flight-simulator training and flying their own remote-controlled planes.
- Team-building activities, including a challenge course and geo-caching, as well as confidence-building activities, such as rock climbing.
- Impromptu design competition, FIRST Robotics activities, and career inventories and discussion.
- On-site facilities tours and activities by female staff at Alcoa Howmet.

GVSU has conducted the STEPS camp for eight years—the first campers are now sophomores in college. The school conducted a long-term study of the participants from the first three years of the program. Results through high school and the first year of college show substantial increases in interest in STEM careers (55% of STEPS participants vs. 32% nationally) and similar results in planning to pursue STEM disciplines in college.



Figure 2 During the STEPs program, students get tour facilities such as Alcoa Howmet.

The GVSU approach to K-12 outreach in the STEM fields appears to be producing positive results. Formal data and anecdotal feedback indicate the participants in these outreach programs are pursuing STEM disciplines in college and careers at encouraging rates. While GVSU has always conducted outreach as a community—and not specifically targeted outreach programs at recruiting—it should be noted that, for more than a decade, the STEM fields have been the fastest growing sector of GVSU. In turn, GVSU has been the fastest-growing university in the state of Michigan.

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Related websites

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Michigan Society of Professional Engineers (www.michiganspe.org)

FIRST Robotics (www.usfirst.org)

Electrathon America (www.electrathonamerica.org)

Grand Rapids Area Pre-College Engineering Program (www.grapcep.com)

Grand Rapids Public Museum (www.grmuseum.org)

Grand Rapids Public Schools (www.grpublicschools.org)

Society of Manufacturing Engineers (www.sme.org)

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