University & Community Partnerships: Growing the Numbers of Underrepresented Students in the STEM Pipeline

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ABSTRACT:
Increasing student interest in science, technology, engineering and mathematics (STEM) careers is a national issue that continues to challenge educators to produce a workforce strong in scientific and technical capabilities. As the demand for technical talent continues to grow, underrepresented groups must become an integral part of this workforce. Precollege STEM programs specifically targeted at women and minorities are invaluable tools in creating a pipeline to higher education. Coupled with additional access, mentoring, and retention programs, these programs increase the diversity of the pool of future scientific and technical workers.

Focusing on students entering the pipeline, Michigan Technological University's extensive precollege programs (Youth Programs) have the strength of a 35 year history. The primary goals of the programs are to increase students knowledge and awareness of career options and to encourage students to become academically prepared for higher education. The core experience is a one-week residential precollege program on Michigan Tech's campus. Programs such as Women in Engineering and the College Access Program, are designed to attract students who are traditionally underrepresented students to STEM fields through hands-on, experiential education.

The most recent longitudinal survey of Michigan Tech's precollege programs (seven years of program participants) shows that past participants ranked program educational content as the number one factor which impacted decisions about higher education, followed closely by career information and a "comfort" factor—helping the students to be comfortable with college and career decisions. In addition, the survey found that over 70% of past participants who responded indicated that the programs increased their interest in pursuing careers in STEM fields. When the data was analyzed by participant ethnicity, the "comfort" factor ranked above all other factors in importance for those students traditionally underrepresented in STEM fields.

With these programs focusing on students in the pipeline, there is a campus-wide effort to increase the awareness of the value of a diverse campus and to create an environment where all students feel comfortable. Michigan Tech's Office of the President (Special Assistant to the President for Institutional Diversity) leads this effort, assisted by the Educational Opportunity Department.

Michigan Tech has an extensive group of partners and supporters with closely aligned goals: to increase the number of students in the STEM pipeline and to create an inclusive environment at the University. These partners include schools, corporations, organizations, and local,

regional, state and national entities. Many of these partners commit financial resources to ensure student success. They also contribute to Michigan Tech's diversity initiatives by offering networks and forums for discussion; access to diverse students; professional development opportunities; programming and retention ideas; national and global career experiences; and advice to students, faculty, staff and administration on local, regional, state, national and global matters.

This paper will focus on the success of the collaboration of Michigan Tech and our external supporters and partners in increasing the number of highly talented, underrepresented students in the precollege STEM pipeline for the technical workforce of the future. It will also provide suggested methods for conference participants to create similar partnerships to support similar goals in their own programs.

NARRATIVE:

Increasing student interest in science, technology, engineering and mathematics (STEM) careers is a national issue that continues to challenge educators in producing a workforce strong in scientific and technical capabilities. While the U.S. has the strongest national economy with the largest per-capita income, its success masks a critical vulnerability (Jackson 2002). A quarter of the current science and engineering workforce will retire by the end of this decade. In addition, this cohort is not being replaced in sufficient numbers, in fact over the past twenty years, the U.S. college-age population has declined by more than 21% from 21.6 million in 1980 to 17 million in 2000 (Jackson 2002; Porter, etal 2001).

As the demand for technical talent grows, and domestic talent has been unavailable or underutilized, the U.S. has turned to foreign workers to fill the gap. In addition, universities are recruiting from the same pool to fill faculty positions. Currently, white males comprise nearly 70% of the science and engineering workforce, but are just 40% of the overall workforce.(US Competitiveness 2001). White females make up 35% of the overall workforce, but no more than 15 percent of the science and engineering workforce. African Americans, Hispanics, Native Americans and persons with disabilities make up 24% of the population but only 7% of the science and engineering workforce (Porter, etal 2001). As the demand for technical talent remains strong, under-represented groups must become an integral part of the technical workforce. A response to this challenge is to strengthen the university presence in grades Pre-K through 12 Mathematics and Science Education (Jackson 2002). In order to create a pipeline to higher education, pre-college STEM programs specifically targeted at women and minorities are invaluable tools. Coupled with additional access, mentoring, and retention programs, these programs aim to increase the diversity of the pool of future scientific and technical workers.

The National Science Foundation reports the number of degrees in the physical and mathematical sciences peaked in the early 1970s, degrees in engineering and computer science peaked in the mid-1980s, and trends in the biological sciences showed a long, slow decline in earned degrees in the 1980s but a reversal of this trend in the 1990s (NSF 2000). There is evidence to suggest that underrepresented groups in science and engineering, particularly women, are attracted to careers where they feel that they can have a positive impact on society. Educational experiences in sustainability, with their focus on societal impact and interconnectedness, should have a broad appeal, especially to young women. Working towards

solving environmental and societal problems resonates with women; young girls will be motivated to study science and engineering if they understand that careers in these fields will enable them to positively impact society (Mihelcic, etal 2003).

Michigan Tech's recent experience in educational/research programs related to sustainability suggests women and minorities may be attracted into careers with a sustainability focus. Table 1 shows the number of women and minorities participating in our sustainability initiatives. Female graduate students in our Master's International program with first degrees in mechanical, chemical, and electrical engineering joined the program for reasons that include: merging personal convictions with career; wanting to learn how to apply technology that is culturally, economically, and socially appropriate; and seeking a change so they can apply their science and engineering skills for the protection of ecosystems and natural resources (Mihelcic 2004; Mihelcic, etal 2006).

Specific Program	Total Students	% Male	% Female	% Minority
MTU/SUBR/NSF/IGERT (First Co-Hort)	12	75	25	50
MTU NSF International Sustainable Development Research Experience	7	29	71	14
MTU/SUBR NSF REU in Sustainability	49	43	57	37
MTU Master's International in Civil & Environ. Engrg.	58	58	42	7
CEE International Senior Design	130	47	53	unknown

Table 1. Diversity of Michigan Tech's sustainability and international educational initiatives

[The far-right column indicates the percentage of students who are minorities. Minority is defined here using the National Science Foundation definition as African Americans/Blacks, Hispanics, American Indians, Alaska Natives, and Pacific Islanders, however, the students represented here are all African American or Hispanic (Mihelcic, etal 2006).]

A recent report by the American Association of University Women, Behind the Pay Gap, identified the following pivotal factors which impact a woman's career and earning power: choice of field of study, family and career choices, and gender discrimination. The report correlating with the table above, states that one method to increase the number of women interested in STEM fields is to promote careers for women in STEM fields in interesting ways; allowing them to see how they could have a positive impact on society through work as an engineer or scientist (Dey, J.G. and Hill 2007, 30).

Research suggests that pre-college outreach is especially successful when participants are given the chance to recognize the relevance and importance of STEM-based academic studies using "real-life" engineering projects. Judith A. Ramaley, visiting senior scientist at the National Academy of Science synthesizes relevant research (Fagan, Crouch, Mazur 2002, 206-09): "It appears clear that creating active participation in…active learning strategies can help students develop the habits of mind that are characteristic of scientists" (Ramely 2005).

Focusing on students entering the pipeline, Michigan Tech's Youth Programs have the strength of a 35 year history. Hosting over 1,500 middle and high school students a year, the programs offer students the chance to investigate careers and academic topic areas in engineering, math, science, technology, and technical arts. Program participants' experience a mini-version of college life, exploring in hands-on, discovery based instructional settings while living in a residence hall on campus or a field site, supervised by undergraduate student mentors.

One of the goals of the programs is to encourage participating students to become academically prepared for careers in the STEM fields. Explorations are led by Michigan Tech faculty and graduate students, and take place using Michigan Tech's research and clinical laboratories and other facilities. Tech's precollege programs began with the Summer Youth Program (SYP), initiated in 1973 to offer students the opportunity to investigate academic and career areas, and to spend time on a university campus. Today Youth Programs offers competitive scholarships - funded by state and corporate partners - for a variety of outreach workshops designed to attract diverse students to STEM fields through hands-on experiential education.

The American Indian Workshop introduces young American Indian students to the excitement and value of a college education. The Women in Engineering and Explorations in Engineering programs provide young women and traditionally underrepresented populations in engineering and science fields, who are academically talented in mathematics and/or science, the opportunity to investigate careers in engineering and science. Through an intensive one-week residential program, participants explore several areas of engineering and science. Educators, university faculty, and practicing minority engineers from industry and the government lead informative sessions and discussions. Each session includes a laboratory experience, a team-engineering project, and provides time to interact formally and informally with role models and talented peers.

Other outreach programs include the State of Michigan King-Chavez-Parks College Day/GEARUP (Gaining Early Awareness and Readiness for Undergraduate Preparation) program which targets middle school students; the Ford Partnership for Advanced Studies (FordPAS) (an academically rigorous, standards-based program that introduces students to the concepts and skills necessary for future success, linking classroom learning with the challenges students will face in post-secondary education and with the expectations of the workplace they will face as adults) program, and other year round outreach programs, both in- and out-of-school time; all designed to increase awareness of careers in STEM fields and to encourage students to become academically prepared for post-secondary education.

The Youth Programs staff completes extensive evaluative research into the programs' efficacy, using both qualitative and quantitative instruments. All student participants complete two written evaluations that give program directors feedback on academic and residential hall

components with the ability to cross-reference feedback by gender, age, and ethnicity. Faculty, residence hall counselors and the Youth Program coordinators evaluate each exploration and the residence hall program annually. Student tracking, evaluation processes, and efficacy studies continue to be a major focus of the program coordination. Curriculum, academic offerings, program management, and target audiences are annually assessed and revised based on these efforts. Regular evaluation and assessment are considered to be a major reason for the success of the programs.

In a longitudinal study of 5,400 program participants surveyed, 708 surveys were returned (13%) and respondents ranged in age from 12 to 32 years old (mean age 19.6). Of the 58% of respondents of college age, 25% of those in college had enrolled at Michigan Tech and 82% stated that the program had a positive impact on their career decisions. Additionally, data shows that past participants ranked program educational content as the number one successful factor, followed closely by career information and a "comfort" factor—helping the students to be comfortable with college and career decisions. In addition, the survey found that over 70% of past participants stated that the programs increased their interest in pursuing careers in STEM fields. When the data was analyzed by participant ethnicity, the "comfort" factor ranked above all other factors in importance for those students traditionally underrepresented in STEM fields (VandenAvond 2001).

Coupled with these programs, and focusing on students in the pipeline, is a campus-wide effort to increase the awareness of the value of a diverse campus and to provide and maintain an environment where all students feel comfortable. Michigan Tech's Office of the President (Special Assistant to the President for Institutional Diversity) leads this effort, assisted by the Educational Opportunity Department. The Special Assistant to the President for Institutional Diversity (Special Assistant) is the President's chief advisor in diversity matters. The Special Assistant has primary responsibility for leading program development and fundraising efforts that support and advance excellence through equity, diversity and inclusion at Michigan Tech. As such, the Special Assistant represents the President and works with the Provost, V.P. for Student Affairs, and Director of Human Resources to foster shared responsibility for diversity initiatives through broad-based faculty and staff efforts to institutionalize programs and processes that embrace the Diversity Framework and affirm the strategic plan.

In 1992 Michigan Tech conducted a climate survey aimed at understanding the concerns of women at Michigan Tech; 385 female faculty, staff, and students completed the survey. The survey's final report (1994) provided a number of recommendations that were implemented to improve the climate for both females and males. Related follow-up included a set of recommendations from the Retention Task Force (1994) and the University's diversity plan, the Diversity Framework (2003). Both documents have provided guidance and initiated actions that significantly impacted the Michigan Tech climate and sharpened its focus on diversity.

To continue this work, the University's first institution-wide Climate Study was initiated recently with the implementation of an institutional-wide climate survey. This extensive survey was designed to elicit perspectives from all students, faculty, and staff on how they perceive and experience life and work at Michigan Tech. The survey included questions that asked individuals to consider various aspects of diversity and how it has or may impact them and their work. The results of this survey, and a review of the outcomes of the previous studies, provide a

comprehensive snapshot of our campus climate and culture. This ongoing Climate Study will assist Michigan Tech in examining its programs, processes, and procedures to ensure that they meet the needs of an increasingly diverse University community.

The Climate Study was initiated with the implementation of a campus-wide Climate Survey that was first given in December 2005. "Climate" was defined as how the campus community perceives and experiences life and work. The Climate Survey also focused on the recognition, understanding, and involvement by individual University community members in Michigan Tech's goal of being an inclusive, diverse community.

As noted earlier, our Youth Program longitudinal survey data, when analyzed by participant ethnicity, the "comfort" factor ranked above all other factors in importance for those students traditionally underrepresented in STEM fields. The following paragraph describing the climate survey response is indicative of the level of engagement at the university by its constituents: A total of 260 faculty, 3,077 students, 288 professional staff, and 143 hourly staff completed the Climate Survey. The overall response rate for each group was greater than 45 percent. An analysis of the composition of each group of respondents indicated they were demographically representative of the target populations within the University community.

The climate study lists five categories of recommendations, with some recommendations overlapping more than one category: 1) The definition of diversity, 2) communication, 3) recruiting and retaining, 4) dialogue, and 5) work environment and space.

While all recommendations are critical to achieving our goals, we will focus here on recruiting and retaining students, faculty, and staff. As we emphasize the need for an inclusive climate, we must continue to create a more-diverse campus. Michigan Tech has many challenges in recruiting and retaining students, faculty, and staff that are underrepresented in the University community; as well as critically absent from some of the disciplines that are our strengths, engineering in particular. To contribute to a national need, we must focus on recruitment and retention of diverse students, faculty, and staff. This requires innovative programs, new policies and processes, and the creation of strong partnerships with schools, community colleges, and the local community. The survey recommendations provide a number of strategies to accomplish this.

Finally, there are recommendations to involve and solicit support from the local community as an important component in creating a welcoming environment. The Climate Survey Report and Recommendations are available on the diversity website http://www.climatestudy.mtu.edu. (Anderson 2007)

Located in Michigan's rural town of Houghton, Michigan, an area with limited visible diversity, Michigan Tech's Office of the President realized the value and necessity of creating connections within the community to advance the University's diversity initiatives. All Michigan Tech students, faculty and staff become engaged in the community at some time or another, whether they are a precollege student or a faculty member. It is important to the success of the University's diversity plan that both the campus and local community be welcoming and inclusive.

> Diversity is often considered in terms of race, ethnicity, and gender, while its underlying value is overlooked. We view diversity more broadly, as a multifaceted resource that offers

> rich, educational benefits to the University. Diversity is key to developing our creative potential. As educators by profession and by heart, we recognize that critical thinking skills are essential to student success. Certainly those skills can be partially learned in the classroom. But in large measure they are honed by experience—the experience that comes through day-to-day interaction with those who are different from us. The more we are challenged by their differing viewpoints, the more we grow, both as individuals and as a community. Most importantly, we learn to relate better with others, to lead, and to adapt.
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> ~ Michigan Tech President Glenn Mroz, 2007 Climate Study Report

The Educational Opportunity department focuses on lifelong learning for traditional and non-traditional students. The department is the home of Outreach & MultiEthnic Programs, which supports the recruitment, retention, and graduation of students. The department provides all Michigan Tech students opportunities to enhance their diversity and world views. The department directs the ExSEL Programs which provide academic and professional development support strategies for students. Special academic programs include Youth Programs (the focus of this paper), Conferences & Institutes, National Student Exchange, and Undergraduate Research.

The current Special Assistant, Chris S. Anderson, is uniquely qualified for her position as she served in the director capacity over the Educational Opportunity department for nearly 20 years. As the Special Assistant, she continues to have oversight over diversity initiatives implemented by the Educational Opportunity department and works closely with the department executive director, Shalini N. Suryanarayana, and her staff to advance existing and develop proposals for new initiatives and seek external funding for ongoing initiatives. A critical responsibility of this position is to match internal and external constituencies and philanthropic funding sources.

Michigan Tech has an extensive group of partners with closely aligned goals: to increase the number of students in the STEM pipeline and to create a welcoming and comfortable environment for all. These partners include schools, corporations, organizations, and local, regional, state and national entities. In addition to providing financial and in-kind resources, these partners support Michigan Tech's diversity initiatives by providing networks and forums for discussion; access to diverse students; professional development opportunities; programming and retention ideas; national and global career experiences; and advice to students, faculty, staff and administration on local, regional, state, national and global matters. This paper focuses specifically on Campus/Community Teams, the Keweenaw Economic Development Alliance, the Diversity/Educational Opportunity Corporate Advisory Board and our Youth Program partners. The alliances that are built with these organized bodies, as well as with the individual members strengthen the University's ability to provide quality educational experiences in engineering, science, and related fields to our students. These kinds of partnerships assure that the University continues to focus on the goal of becoming a truly diverse campus. A key ingredient to the strength of our partnership infrastructure is the overlap in service by individuals in our external supporting bodies. For example, the same person might be an alumnae/alumnus of the University, a KEDA member and a Corporate Advisory Board member.

Figure 1: Pipeline Partnerships

	Fund students to attend Youth programs	Provide role models for precollege students	-Fund and support student organizations and undergraduate outreach programs -Provide co-ops and internships	Mentoring and guidance	Jobs
Corporate Advisory Board	x	x	x	x	x
Keweenaw Economic Development Alliance	x	x	x	x	x
Campus Community Teams	x	x		x	
Youth Program Partners	x	x		x	

Table 2: Examples of pipeline partnership support

Keweenaw Economic Development Alliance

The Keweenaw Economic Development Alliance (KEDA), formerly the Keweenaw Industrial Council, takes a leadership role in Houghton, Keweenaw and Baraga Counties—helping to expand and diversify the area's economic base in order to create family sustaining employment and to increase the economic well-being of our area.

KEDA designs and implements proactive, environmentally sensitive programs that are focused on retaining and expanding existing firms, starting up new businesses, attracting entrepreneurs and companies to the Keweenaw and initiating projects that create the conditions for future economic growth. (Musser 2007)

Our relationship with KEDA has grown from annual support of our precollege programs with individual members funding local students attendance at a Youth Program, to a relationship integrated through many areas of the University. The KEDA meetings serve as a venue for member announcements and member-to-member discussion, resulting in increased community awareness of and attendance at cultural events, community support for external grant applications, and internship positions for Michigan Tech students within the community. Additionally, we share professional development activities and seek guidance from KEDA members in forming campus/community teams which solve mutual problems, create business partnerships and celebrate diversity.

KEDA/Michigan Tech Joint Initiatives include:

KEDA/Tech Summer Youth Program Scholarships—serves 12-15 students annually—year 5

KEDA/Michigan Tech ExSEL Program Internships—serves 2 -5 students annually—year 2

KEDA support for Michigan Tech external funding proposals—multiple proposals annually

Institutional Diversity/Educational Opportunity Corporate Advisory Board

A significant percentage of the financial support for Michigan Tech's precollege and multicultural programs that serve to help recruit and retain students who are underrepresented in engineering and related fields comes from corporate, and foundation donations, as well as service contributed by the University's academic departments. Maintaining a high level of support for these programs is a priority. Assuring their highest quality is another. As previously noted, the University president is a proponent of building alliances and has encouraged the development of departmental and college advisory boards. These boards provide valuable input and diverse perspectives to the academic areas. Companies who support Youth Programs, recruit at Michigan Tech, collaborate with faculty on research, and have other relationships with the campus are invited to participate in our Diversity/Educational Opportunity advisory board whose main goal is to promote diversity.

The objectives that the Board works to achieve are to:

- offer input concerning the Department's short and long term goals in its strategic plan
- advocate to the campus administration for the Department goals
- help the Department engage other units in diversity activities
- provide advice concerning resources (people, potential partnerships, and funds) for Educational Opportunity programs

- provide direction in the development and improvement of the Department's precollege career explorations
- recommend improvements in advertising and marketing strategies for Department programs
- provide advice for fine tuning Educational Opportunity business processes

The greatest impact the Board has had is in its very presence on campus. It aggressively questions staff, faculty, students and the upper administration about our commitment to diversity. The Board is an advocate that consistently reminds our fairly isolated campus that we must be a diverse university and that we can be successful at accomplishing this strategic goal.

Sample activities that have been spearheaded by the Corporate Advisory Board:

1. Michigan Tech Spotlight Nights—hosted by Consumers Energy in Jackson, Michigan: an evening designed to increase awareness of careers in STEM fields as well as Michigan Tech Youth Programs
2. Whirlpool Foundation College Access Program—funded by Whirlpool Foundation, 35 Benton Harbor, Michigan area students have attended the Summer Youth Program, and subsequently are chosen for internships in the Whirlpool corporation
3. Funding at various levels ranging from $1,500 to $45,000 annually to support recruitment and retention of traditionally underrepresented students in STEM fields

Campus/Community Teams

Campus/Community teams have been developed with guidance from KEDA and the Corporate Advisory Board. These teams were developed to solve mutual issues on campus and within the community, as well as to achieve similar goals by jointly implementing outreach activities that positively impact precollege and undergraduate students, as well as faculty. These unique teams were able to be formed because of our unique and rural small community.

Sample Teams:

Dual Career Committee: This committee was formed to address the needs on campus and in the community to attract talented and diverse human resources to the area.

Presidential Community Council: This roundtable style group is designed for the President of University to interact and become engaged with the community.

Cherry Commission/Mroz Commission: This commission was developed to address Governer Jennifer Granholm's goal to double the number of college graduates in 10 years. Originally called the Cherry Commission and comprised of local school district and community officials, it has transformed into the Mroz (University President Glenn Mroz) Commission and currently funds high school enterprise programs. The High School Enterprise Program provides funds to pay a teacher/coach, and for project costs. Training is provided at a summer workshop on the Michigan Tech campus. Then, throughout the year, coaches can tap Michigan Tech students and faculty as resources. Projects may be completed in one year, or can be a multi-year effort.

Department of Cognitive Science & Learning and the Copper Country Intermediate School District: This team collaborates with other intermediate school districts throughout the state on

Michigan Department of Education Improving Teacher Quality grants and other funding opportunities. The grants fund numerous academic and practical secondary educator workshops, as well as cultural training to improve delivery of curriculum in the classroom.

Precollege Program Partners

Precollege program partners are critical players in our recruitment efforts. Coupled with financial and in-kind support from our corporate and organizational funders, we work together with our partner schools, foundations and organizations to provide access to traditionally underrepresented students.

Precollege program partners such as the Detroit Area Precollege Engineering Program (DAPCEP) (Detroit, Michigan), Make a Difference Youth Foundation (Chicago, Illinois) and ASPIRA (Chicago, Illinois) provide venues for us to access diverse students. For example:

1. The Detroit Area Precollege Engineering Program funds 30 precollege students to attend a Summer Youth Program each summer. Many times, this is the first time away from home for many of the program participants. The Youth Programs staff strives to provide a welcoming and comfortable environment for these students. Additionally, Michigan Tech has partnered with DAPCEP on an external funding proposal to the National Science Foundation Information Technology Experiences for Students and Teachers (ITEST) program, serving 120 students annually.
2. ASPIRA Illinois has implemented the Ford PAS program in four of their charter schools. ASPIRA, Inc. of Illinois is a Puerto Rican not-for profit organization committed to the self-determination of Latinos through education, leadership development and cultural awareness.
3. Precollege students from the Make a Difference Youth Foundation (MDYF) in Chicago, Illinois practice e-tutoring with Michigan Tech students. This program allows for the precollege students to get help with their homework in an instant-messaging style, while receiving personal support and mentorship. MDYF is an educational foundation dedicated to the academic and social development of youth. The goal of MDYF is to work with youth in creating the desire to succeed while understanding the importance of helping those in need.

Other sample Youth Program partners are listed below:

Lewis Cass Technical High School—Detroit

Michigan Tech/King Chavez Parks College Day/GEAR-UP (Gaining Early Awareness and Readiness for Undergraduate Preparation) Program—Houghton

Beecher Scholarship Incentive Program—College Access Program—Flint

Supporting diversity by building partnerships has resulted in greater numbers of diverse students on campus as evidenced by the following chart. The chart shows the number and percentage of students who have participated in a Youth Program, and subsequently applied to and/or enrolled at Michigan Tech as an undergraduate. (Lehman 2007)

2007 graduation date	Participants	# Applied	% Applied	# Enrolled	% Enrolled (of participated)	Yield Rate% (of applied)
EIE	90	29	32%	11	12%	38%
SYP	528	131	25%	59	11%	45%
WIE	72	29	40%	13	18%	45%
Total	690	189	27%	83	12%	44%
2006 graduation date	Participants	# Applied	% Applied	# Enrolled	% Enrolled (of participated)	Yield Rate% (of applied)
EIE	63	16	25%	6	10%	38%
SYP	659	166	25%	78	12%	47%
WIE	151	61	40%	31	21%	51%
Total	873	243	28%	115	13%	47%
2005 graduation date	Participants	# Applied	% Applied	# Enrolled	% Enrolled (of participated)	Yield Rate% (of applied)
EIE	95	23	24%	9	9%	39%
SYP	490	110	22%	49	10%	45%
WIE	122	43	35%	20	16%	47%
Total	707	176	25%	78	11%	44%
2004 graduation date	Participants	# Applied	% Applied	# Enrolled	% Enrolled (of participated)	Yield Rate% (of applied)
EIE	91	24	26%	7	8%	29%
SYP	428	106	25%	56	13%	53%
WIE	91	45	49%	18	20%	40%
Total	610	175	29%	81	13%	46%
Grand Total	2880	783	27%	357	12%	10%

Table 3: Youth Programs participants enrolled as undergraduates by graduate year

Tips for creating pipeline partnerships:

Networking, no matter how cliché it may seem, is an invaluable tool in the advancement of similar goals. Many of the relationships we have developed come from conversations with individuals. Corporations and foundations are comprised of large networks of people and truly, through an individual is how to increase awareness of your organization within large entities.

When approaching potential partners, consider how the partnership can be mutually beneficial. Approach them with a clear representation of how the partnership will benefit them, and point out what you can offer their organization (for example, web site or other marketing

avenues to highlight their organization, sharing professional development opportunities, leveraging each other's resources when applying for external funding, etc.).

Locally and regionally: look for business and professional organizations whose goals are to advocate for youth and/or advance the economic development and growth of the local community. Groups advocating for youth could include gifted & talented programs, local schools, service programs, youth foundations, and mentoring programs. Examples of organizations focusing on community development may be an economic development alliance or the chamber of commerce. Consider offering to host one of their regular meetings at your facility/campus. Alternatively, you should also invest time in visiting their sites.

State-wide: investigate the state office of labor and economic growth, the state department of education, and attend state conferences. Meet with your state legislators.

Nationally: attend national conferences and seek funding opportunities through federally funded programs such as those offered by the National Science Foundation

Create an advisory board, invite people to join that have an interest in advancing your goals or would benefit from advancing your goals. Identify mutual areas of interest, ask for member's knowledge and expertise, and then request financial support. Provide venues for them to offer feedback. For example, a list of recommendations for your leadership team.

Finally, be aware of the goals of all areas in your organizations. If a relationship develops but the partnership does not prove to be mutually beneficial, redirect the potential partner to another group in your organization with whom they would find a better fit. Invariably, helping others does come back to help you.

In conclusion, Michigan Tech has built alliances with schools, corporations, organizations, and local, regional, state and national entities that have similar goals: to increase the number of students in the STEM pipeline and to create an inclusive environment. These partnerships have resulted in an improved awareness of the value of a diverse community and improved campus/community relations. They have also affected recruitment and retention. Minority youth organizations whose mission is to provide educational opportunities for their members provide support for their students to attend a Youth Program, allowing them to experience first-hand what it is like to be on a college campus and to become oriented with classroom and laboratory settings, dining and residence halls, and to interact with faculty and staff, and peers. Attending a Youth Program allows them to experience meeting the stranger who is going to be their roommate much earlier than their freshman year in college. As noted earlier, the "comfort" factor was most critical for those students who are traditionally underrepresented in STEM fields, and both the academic and residential portions of the program allows this comfort level to grow. Twelve percent or 357 of 2880 Youth Program participants with high school graduation years of 2004, 05, 06 or 07 have enrolled at Michigan Tech (Lehman 2007) .

The corporate alliances translate into greater opportunities for all students, including practical and relevant work experience through internships and co-ops throughout their college careers. Corporate support of student organizations such as the National Society of Black Engineers, Society of Women Engineers, Society of Hispanic Engineers, and others also help with retention of these students.

Ultimately, the precollege programs and diversity initiatives at Michigan Tech have translated into affinity, not only for the University, but also for the students who are entering the

pipeline, and those who are in the pipeline. One of many Youth Program advocates is Derhun Sanders. Mr. Sanders was a Youth Programs participant, then he enrolled at Michigan Tech and as an undergraduate, worked as a counselor in the Youth Programs and was active in minority student organizations, and currently, through his employer, earmarks funding for outreach programs at Michigan Tech. He also serves as a role model speaker for a week each summer, interacting with precollege students from his hometown of Flint, Michigan.

Everyone in STEM fields share a desire to increase the number of students in the STEM pipeline, with a special focus on students traditionally underrepresented in these fields. We all also want a welcoming and inclusive environment for all students. We want to share our successful and best practices with others who have overlapping goals, with the hope that new strategies may be born.

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