

How many of Your Colleagues/Students Have a Disability?

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Abstract

For most people who work in the fields of science, engineering or mathematics, it is obvious that very few, if any, of their peers have a disability. Several factors have been identified that contribute to this underrepresentation. These include: 1) Lack of role models for students with disabilities, 2) High school teachers' inadequate knowledge of accommodations readily available at the college level; 3) Poor to little high school to college transition planning for students with disabilities; and 4) university faculty's lack of experience in recruiting of and providing accommodations to students with disabilities.

Introduction

In the 1960's and 1970's federal legislation was enacted that drastically changed the educational opportunities for children with disabilities. Prior to this, it was common for children with disabilities to be grouped together in segregated classrooms, which significantly reduced learning opportunities. Presently, pre-collegiate public education is mandated to provide these students with the least restrictive learning environments--i.e., to share the same educational options as non-disabled students through "mainstreaming" disabled students into the standard classrooms when feasible. This process, more recently referred to as "inclusion," removes major barriers to students wanting to maximize their education, including those with the most severe and limiting disabilities. This is certainly a major contributor to the increase in the numbers of students with disabilities enrolling in and graduating from post-secondary institutions. Another contribution to increasing the prevalence of students with disabilities who pursue science, engineering, and mathematics is the increasingly affordable and versatile technological options in educational settings. Despite the improved accessibility to primary/secondary education for students with disabilities, surprisingly few of them pursue **science, engineering or mathematics (SEM)**.

Underrepresentation of Students with Disabilities in SEM

The largest minority group in the United States is the population of individuals who have a disability. According to "Disability in the United States: A Portrait from National Data,"]

- 13.5% of Americans *outside* of care-giving institutions have disabilities; most of them are *under* the age of 65. This large group of working-age, non-institutionalized individuals are in a sense financial y disabled:
- 27% of the disabled population has a family income under \$10,000
- only 8% of families with incomes over \$35,000 per year include a person with a disability.



Relatively few sources indicate that the disability representation within Science, Engineering, and Mathematics (SEM) is proportional to the population without disabilities. According to the NSF Report "Indicators of Science and Math Education 1992" p. 1632, the National Center for Education Statistics indicates that the science major enrollment of students with disabilities have the "same proportions" for students without disabilities. The type of disabilities is not addressed, however. Many disabilities are difficult to identify due to people not realizing or not admitting they have a disability, or for whatever reason they do not seek assistance from organizations that act as a conduit of related research on these matters. Unlike gender and race, disability status is difficult to track due to 1) vague definitions, 2) disabilities increases with age, and 3) there may not be as much motivation for self-identification in a society that continues to stigmatize disabilities. So the extent of the underrepresentation remains unclear, and different reports have varied figures based on small sample sizes. What is reported is:

- *Less than 1%* of Federal funds earmarked for promoting underrepresented populations in SEM is spent on persons with disabilities (the largest underrepresented, disadvantaged minority group), while
- 58% of these funds are spent on racial and ethnic minorities and
- 7% on economically disadvantaged groups.

("The Federal Investment in Science, Engineering, and Technology Education: Where Now? What Next?" June 1993 NSF Report.)³

Although there are discrepancies in various reports, there appears to be a widely accepted understanding that there exists some underrepresentation of people with disabilities in the fields of Science, Engineering, and Mathematics (SEM). That is, there are generally proportionately fewer people with disabilities in SEM than in other areas. This is supported by studies such as the National Task Force on Women, Minorities, and the Handicapped in Science and Technology from former president Ronald Reagan's Science Advisor⁴ and the NSF Task Force on Disability⁵ (although that sample size was too small to satisfy the professionals who conducted the study, according to a personal email contact). There is ample evidence that people with disabilities are underrepresented in higher education and employment. According to a recent Harris Poll (National Council on the Handicapped, 1988), 33% of disabled college graduates are unemployed.⁶ Does this have anything to do with the this group's pursuing fields that are less marketable than SEM?

Regardless of the actual representation figures, it is a legitimate question to ask: "Why aren't there *more* people with disabilities in SEM?" SEM Professors at the University of Illinois, Champaign-Urbana (UIUC) campus ask this often. While UIUC boasts one of the most accessible campuses in the country, the world's far most successful wheelchair athlete program, and internationally renown SEM programs, there is still a mysterious underrepresentation.

- While several thousands of UIUC students are enrolled in SEM programs, only 14 students with motor or sensory disabilities (who self identify to the university) are pursuing a SEM program. [Recall the previous citation indicating that 13.5% of an associated population has a disability.]

As technological options increase in terms of affordability, power, and versatility, it is natural for some to assume that the enabling role of technology would inherently remove many of the barriers people with disabilities face. Such technological aids include the Internet, simulation software, computer applications that assist in alternative communicating and information processing, assistive devices for making computers accessible to those with special needs, and amplification hardware. This is especially true in SEM areas, which generally promote technology for enabling all individuals. It is also promoted by education communities that advocate moving away from traditional teaching approaches, in favor of restructuring -



rather than amplifying - conventional methods.⁷

Why is this underrepresentation phenomenon such a problem?

Students with Disabilities:

-Assume that factors such as visual, hearing, and mobility impairments do not restrict cognitive functioning or fascination with quantitative sciences. [This is not to suggest that all students with disabilities can or want to pursue SEM; rather, this is to note that the proportion should be not be drastically less than it is with the able-bodied population.] It is reasonable to then conclude that there are some people with disabilities who are being misdirected, for whatever reasons, into non-SEM fields despite inherently promising aptitudes and interests in SEM areas. This is clearly a problem for those potentially scientific students as they are missing out on opportunities to enjoy a career in which they might excel most.

SEM community:

It is also a problem for the SEM community to miss out on the kind of diversity that is so desirable in problem-solving teams. As eloquently put in one employment ad by Xerox, "People who have met difficult challenges- bring more to the table," followed by a photo featuring a man in a wheelchair with a laptop computer at a round table conference meeting.

Schools and Workplaces:

This underrepresentation phenomenon is also a problem for American schools and workplaces, in the event they are violating the Americans with Disabilities Act, passed in 1990. Teachers' performance may be limited if they are insufficiently preparing students with disabilities to enter SEM fields: Teachers who accept new instructional challenges for students with special needs may be stimulated to grow as an educator. These trends may be analogous for employers. In both schools and the workforce, peers maybe enlightened as they are exposed to counter examples to misconceptions suggesting students with disabilities cannot prevail in SEM. When non-disabled students and workers are exposed to individuals who overcome disability barriers, they too may be inspired to overcome other obstacles.

America:

The mysterious trend of losing potential scientists of any ability/appearance/gender is a problem for the nation in general. To be able to compete in a modern world economy, it is beneficial for us as a nation to have a larger gross national (SEM) product. Furthermore, American tax dollars go towards supporting unemployed people with disabilities. As more people with disabilities enter financially secure, independent lifestyles associated with SEM careers, more social service funds can be applied to alternative causes.

Driving Theories for Investigating the Problem

The representation figures within SEM fields for people with disabilities vary across reports, depending on the age group studied, the type of disabilities included, and the data-collection methods used. In the case of disabilities that effect only vision, hearing, and mobility, there is no reason to believe that individuals with such impairments have less aptitude for SEM than those without disabilities. Therefore, the reasons for this population to enter fields other than SEM must involve a personal history that eventually lead them away from SEM. For those few "survivors" who have nevertheless conquered SEM, there must have been an enfolding of academic, personal, and physical developments that were infused into the individuals'



lives such that they were enticed and enabled to pursue a SEM path. What critical turning points, influences, or milestones have enabled --for example--a blind or paraplegic person to succeed in SEM? What struggles were there, specific to those with disabilities, to make the challenge of SEM studies especially difficult? How does one overcome such struggles? What advantages might the disabilities present, if any, in the pursuit of SEM?

The statistical information regarding the underrepresentation of individuals with disabilities and their prevalence in SEM is merely the result of the personal *process* questioned above. The authors are engaged in a study which aims to examine that process. It explores the essence of the life stories of mostly people with sensory/mobility impairment, in terms of the history leading up to career choices. In order to investigate the forces behind the aforementioned phenomenon of underrepresentation, in-depth interviews, focus groups, and observations have been used as a primary means for gathering qualitative information. Students with disabilities who have pursued SEM at some collegiate level as the subjects of the study. To shed light on these findings, a survey has been used to measure the prevalence of certain estimated barriers, for a more quantitative view of the problem.

Purpose of the Study

The lack of representation has led to a three-year investigation sponsored by the National Science Foundation to answer two primary questions:

- 1) Why are people with disabilities underrepresented in Science, Engineering, and Mathematics (SEM)? [Does the cause lie mostly in the student's disposition, in the form of a lack of interest, confidence, aptitude, or insufficient time --or the recruiters' disposition, in the form of patronizing teachers, insufficient administration funds, overprotective parents, unaccommodating SEM professors?]
- 2) What are the potential solutions to the causes?

Secondary questions:

- What roles do teachers play in the recruitment of people with such disabilities in SEM? If teachers are not effectively recruiting, is this attributed to their lack of interest, resources, and/or knowledge? In the case of the latter, what knowledge is lacking--SEM awareness or disability awareness? How do students with disabilities expect their teachers to better accommodate them in SEM classes?
- What are the students' conjectures about underrepresentation? Consider a.) the observations/experiences/anecdotes with their disabled peers and b.) the students' generalizations about broader issues such as education, politics, psychosocial trends, etc.
- How does technology act as a "learning ramp" which may make SEM accessible to those with disabilities?

Methods

In order to thoroughly answer the primary and some secondary questions about potential SEM students with disabilities, both qualitative and quantitative methods are employed. A survey is being used to measure the prevalence of various reports of anticipated barriers such as psycho-social trends and physical obstacles. To remain open to information that may not be anticipated, and to information that cannot be addressed through a survey format, several naturalistic data collection practices are used, including interviews and focus groups. These methods could not be applied without cooperating teachers at participating high schools and



UIUC's SEM departments. Project PURSUIT has been granted access to students and teachers in exchange for the services and resources PURSUIT offers.

Project PURSUIT has been serving educational institutions in order to gain access to information involving disability and SEM issues. By providing known information, in the form of multimedia, presentations, training workshops, original documentation, and published literature, we have had the opportunity to learn new information and confirm some theories. This on-going process involves administering surveys and documenting items including attitudes and concerns of educators and the interests of students with disabilities. This next section will outline the means of service provisions.

Dissemination

To begin enticing schools to cooperate with PURSUIT, they are informed, "Project PURSUIT is committed to providing information about disabilities and accommodations to students with disabilities, teachers and counselors in high school, as well as SEM professors at UIUC. Project PURSUIT attempts to increase the students' self-confidence and to remove misconceptions anyone has about these students' limitations, as we gather additional information." Such information provisions, or dissemination means, are listed as follows:

Workshops

Full day workshops are provided for high school teachers and counselors in local convention centers. The workshops offer information about disabilities and accommodations, presentations by UIUC students with disabilities who share valuable personal experiences, and inspirational videos of students with disabilities who excel in SEM at other institutions. Professors identified as special advisors in UIUC SEM departments present information to teachers about their individual departments and the accommodations that they offer to students with special needs. At these workshops, teachers and counselors are invited to offer their insights and ask questions about assisting/recruiting students with disabilities into SEM. There are also related workshops for these students and their parents. They are given printed and spoken information about disabilities and available resources, in addition to information about college options and how parents can become more involved with the teachers and the transition from high school.

Special Advisor Program for SEM Professors

The special advisors in the SEM departments at UIUC are considered "advocates" for students with disabilities, so students can be assured there is someone "on their side" when complications arise. These advisors are first given workshops which cover sensitivity training, the Americans with Disabilities Act, suggestions for problem-solving with other colleagues, and information about accommodations. The SEM departments are also being provided a comprehensive library of books and journal articles for resources on accommodating SEM students with disabilities.

As the SEM professors are approached for dealing with the problem of underrepresentation in their fields, they in turn offer us valuable information, whether or not they become special advisors. Some innovative advisors offer us valuable information about how students with disabilities in their science specialty can be accommodated. Others demonstrate absence of or distortion of information on disabilities and accommodations.

College Student Presentations for High Schools

As in the workshops, the UIUC SEM students with disabilities give presentations to high school



students with disabilities at high school campuses throughout Central Illinois. These presentations provide opportunities to inform students about the peer/mentor program and the summer camp program offered through Project PURSUIT. The peer/mentor program offers high school students with disabilities the opportunity to be matched with students with disabilities from the University of Illinois. This allows for communication about issues related to succeeding in college and having a disability. Means of evaluating such impact are in the form of self-reporting and possibly by electronically monitoring their email contacts.

The Internet as a Resource-A Web Server

Another component of PURSUIT activities is the WWW site “<http://pursuit.rehab.uiuc.edu>” This dynamic outreach medium has put us in touch with students, scientists, prospective mentors, career counselors, and concerned “regular folks” from around the globe. The number of files accessed per day is increasing somewhat exponentially over the past few months, and is now up to roughly 1100 of hits per week. Interestingly, the charismatic web master of this elaborate site is one of the 14 UIUC SEM students with a disability-- he is a junior computer science major with a math minor and is legally blind. The web site has been a valuable data-collection source, as it offers a survey form and it tracks which of our files are read most often.

Minigrants

PURSUIT offers minigrants of up to \$5,000 to high schools for improve academic environments for the student with special needs, in the form of accommodations and resources. This forum in which SEM or Special Education educators are encouraged to redesign instruction tells us something about what this group perceives to be problems and solutions. They are required to give an evaluation of their program and materials to monitor the impact it has on their students with disabilities.

Poster

For distribution in schools and museums throughout the country, 5000 posters are being printed to serve multiple purposes. The scientific graphics and photographs of SEM role models (students and accomplished scholars) who have disabilities. This message shows the general public that the disabled population is capable of pursuing SEM. The message also serves to entice students with disabilities to consider pursuing these fields of study. In exchange for this poster and other PURSUIT-created materials, we ask that recipients participate in our other programs and in research activities.

Results

The following are results found to date:

- 1) Transition planning to facilitate the students' entry and success in college is severely inadequate. The students, parents and high school teachers (including special education teachers) are not aware of the accommodations available at the college level or how to access them. Some of these accommodations include increased time on exams for students with visual or mobility impairments, instructional software as alternatives to traditional teaching, notetakers for students with hearing or upper limb impairments, and accessible housing and transportation.
- 2) University faculty are aware of the presence of students with disabilities on campus, but most admit ignorance in how to interact with and provide accommodations for these students. Common questions asked



by the faculty are:

- “Am I allowed to approach a student and talk to her about her disability and desired accommodations?”
- 1 “How can I make accommodations?”
- 1 “Am I supposed to comply with all the accommodations the student requests?”
- 1 “What am I legally required to do . . . or not do?”

3) Parents, teachers and students have all identified that a lack of role models with disabilities involved in SEM careers is a contributing factor to the underrepresentation of this population in college SEM programs,

4) For those students with disabilities who have not been fully mainstreamed into all regular classrooms throughout their education, many of them have been placed in “special” classrooms that failed to sufficiently challenge the students SEM understanding. This is not to say that special classrooms should be eliminated; rather, the classrooms should offer appropriate SEM education. This has not been possible in many cases because special education teachers are not SEM specialists. However, there is no reason they cannot collaborate with the SEM teachers to find adequate instruction through pooling resources.

5) For those students with disabilities who have been mainstreamed into SEM classrooms, some of them have received too little attention or the wrong kind of attention because SEM educators have not been sufficiently trained on disability issues. Again, collaboration is called for, according to many groups.

6) The 14 UIUC students with disabilities who have succeeded in SEM seem to have done so due to a wide variety of reasons: a) They have all had some very supportive teachers and family, b) they appear to have an intense sense of motivation and optimism, and c) they have had access to expensive technological alternatives such as computer applications and powerful adaptive equipment. These are factors that do not appear *as* necessary for able-bodied students to thrive. It has been determined that disability does not necessarily drive a student away from SEM. To the contrary, the disability in many cases brings the student toward the sciences in order to make a contribution to the disabled population or to offer an alternative to a previously chosen major that relies on blue-collar physical labor. Some cases show no correlation between SEM interest and disability. There were two cases where a SEM student chose to abandon SEM at some level in order to pursue disability-related opportunities such as wheelchair athletics or rehabilitation clinical services. Stereotyping with an element of accuracy does not seem possible.

7) The survey results show that some anticipated barriers are universally reported, such as the lack of role models of people with disabilities who are in SEM. Other barriers are controversial, such as whether teachers are unaccommodating (students report this more than teachers do) and whether students are not “up to par” for SEM (teachers report this more than students do.) Quantitative results are inconclusive, as the sample size for students with disabilities remains too low at this writing.

Overall conclusion so far:

Every individual involved in the process of preparing students with disabilities for SEM fields can make a contribution in reducing the underrepresentation by actively learning, caring, thinking, and communicating.



References

- 1 Disability in the United States: A Portrait from National Data.
- 2 National Science Foundation Report, "Indicators of Science and Math Education" 1992, p. 163.
- 3 National Science Foundation Report, "The Federal Investment in Science, Engineering, and Technology Education: Where Now? What Next?" June 1993.
- 4 National Task Force on Women, Minorities, and the Handicapped in Science and Technology.
- 5 NSF Task Force on Disability.
- 6 Harris Poll, National Council on the Handicapped, 1988.
- 7 Roy Pea, *Cognitive Technologies for Mathematics Education* p.89, 1987

Bibliographic Information

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SARAH WEAVER oversees the workshops and presentations offered through Project PURSUIT. She is best known for her "Dream of College" message she gives throughout central Illinois to high school students with disabilities. Her training is in psychology and her background is in rehabilitation counseling for both college students and hospital patients.

1. "Disability in the United States: A Portrait from National Data,"
- 2.

