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Creating Opportunities for Youth
With Disabilities to Achieve
Successful Futures

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Building Bridges Toward Science Careers for Youth with Disabilities

By Peg Lamb, Mary Brown, Bill Hodges, and Dave Foy

Introduction

Several researchers have addressed the issue of accommodating students with disabilities in college science classrooms (Brazier, Parry, & Fischbach, 2000; Womble & Walker, 2001). However, little research has focused on the types of accommodations and supports needed for students with disabilities at the college level (Stodden, 2000). This brief outlines results of research conducted by the Bridges Project funded by the National Science Foundation Program for Persons with Disabilities. The major goals of the project were (a) to create a model facilitating greater access for students with disabilities to postsecondary education and careers in science and technology, and (b) to investigate issues related to the transition from high school to college for students with disabilities.

The Bridges Research Project

Students with disabilities are entering college in increasing numbers. According to HEATH Resource Center, postsecondary enrollment for students with disabilities has increased 173% between 1989 and 1998 (Henderson, 1999). Despite increased enrollment, successful outcomes remain low, with only 25% of students with disabilities earning an associate's degree after five years of study at community colleges (Burgstahler, Crawford, & Acosta, 2001). According to the U.S. Department of Education, 32% of students with a learning disability reported not receiving the services or accommodations they needed at the postsecondary level.

In high school many students with disabilities are excluded from general science classrooms, making the transition from high school to college science courses more challenging. The Bridges Project attempted to address this issue by examining the differences between high school and college science curricula and the transfer issues that might prevent success.

Bridges researchers sought to gather information to promote a seamless transition for high school students with disabilities to math, science, engineering, and technology education at community colleges. A team of individuals from the partner organizations, Holt High School (HHS) and Lansing Community College (LCC) in Michigan, investigated student transfers involving students with disabilities needing special assistance who might wish to pursue coursework in math, science, and technology. Nine of the students were from HHS, and 16 were from high schools in the Lansing Tri-County Region.

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Discussion within the research team centered on the differences and similarities of the two institutions and expectations of their students. Holt High School is in a suburb approximately 10 miles from Lansing Community College. HHS sends 30% of its graduating class to LCC each year. HHS has an inclusion policy, which means that students with disabilities are accommodated within regular education classrooms. Subsequently, students with disabilities have been successful in math, science, and technology classes. HHS is a suburban school with approximately 17% of students claiming a specific non-Caucasian ethnic identity. The total population of the high school is approximately 1,200, but includes only 10th through 12th grade. More than 60 percent of the graduating seniors enter college. And, within the high school, more than 200 students are classified as needing accommodations.

Lansing Community College has approximately 19,000 students. Students with disabilities must register with the Office of Disabilities Services with documentation validating their need for accommodations. The science department hires instructors exclusively for their knowledge within the science discipline; the majority of the instructors have neither a teaching certificate nor experience within formal education classes, and little, if any, knowledge about accommodating students with special needs. The total minority enrollment at LCC is very similar to the minority enrollment at HHS with nearly 16% of students of minority status. Nearly 30% of students enrolled at LCC intend to transfer to a four-year institution.

Each LCC student is required to show competency either by waiver from previous experience or testing in reading, writing, and math. Students who cannot demonstrate college-level skills take skill-building courses to remedy their deficiencies prior to their enrollment in academic-level courses, which are transferable to universities across Michigan.

At HHS, students meet with their science class four and one-half hours per week for 19 weeks. The time is structured so that students meet for a one-hour block. Teachers expect about two or three hours of independent work per week compared to six hours of class time per week for 16 weeks at LCC. The typical college science class occurs in a two- or three-hour time block, and instructors expect about 15-18 hours of independent work per

week. In sum, not only are college science students expected to learn more independently, but they are also expected to learn at least three times as fast as high school students.

At HHS, laboratory experience within the sciences is expected. There are no science classes that have a pure lecture format. However, at LCC, laboratory experiences vary according to discipline. In physics and chemistry, the laboratory is a separate course not necessarily taken by all students enrolled. In the biological sciences, one of the three sessions each week is lab-based. Currently, it is only within the integrated sciences, offered primarily for nonscience majors, that the laboratory experience is infused through the entire course.

At HHS, each student takes six classes at a time, and there are 24 students per teacher per class. LCC students are typically enrolled in three or four classes or 12 to 16 credits. The student to teacher ratio is comparable, with 24 students in lab courses and 30 in lecture courses. This contrasts with universities across Michigan where beginning-level science lecture courses may have an enrollment of a few hundred.

Each institution has curriculum guidelines that determine the science content and pedagogy of the courses offered. At the high school level, curriculum is driven by the state's objectives and benchmarks. Students are tested through the Michigan Education Assessment Program (MEAP) with scores made available to the general public. At the community college, the standards for curriculum come from accrediting agencies, such as the North Central Association of Colleges and Schools. Advisory committees including members of the community who employ students in science-related careers (specifically within the six science certificate programs) also determine curriculum. Because 30% of students intend to transfer, universities evaluate community college science courses based on their acceptance or rejection for transfer.

Another area of contrast is the final exam. Instructors at HHS have complete autonomy on the content and format of their final exam as long as they honor state curriculum standards. Collaboration is encouraged and alternative assessments are permitted. At LCC the science department promotes consistency of all classes taught by many instructors by having final exams developed by a course coordinator who is full-time faculty member. Generally all students enrolled in a particular course take the same final exam.

Accommodations and curriculum modification are approached very differently by the two institutions. Accommodations are changes in materials or procedures that provide students with disabilities access to instruction and assessments (Thurlow, 2002). They do not substantially change the instructional level, the content of the course, or the performance criteria. Modifications are adaptations that are made to the environment, the curriculum, instruction, or assessment. A modification changes what a student is expected to learn and demonstrate. It *does* alter the instruction level, the content of the course, and the performance criteria (Castagnera, Fisher, Rodifer, & Sax, 1998).

In terms of accommodations, all LCC students have Internet access via computer labs on campus, access to a Blackboard Web site providing direct communication with instructors and classmates, and access to many skill-building classes for students who need developmental assistance. HHS does not provide such services; however, it offers a structured study-skills class for students with disabilities. Both institutions provide traditional accommodations for students with disabilities, such as Braille, large print, signers, test readers, extended time on exams, books on tape, audiotaped lectures, note takers, and a quiet room for testing.

At the high school level both eligibility and accommodations are determined by an Individualized Educational Program (IEP) committee comprised of the student, parent, and educators. The IEP is written annually and is a legally binding contract until the student exits the program or graduates. The IEP committee has the authority to override both local and state curriculum requirements. At the college level the institution determines the eligibility of the student and the accommodations to be provided. There is no written equivalent of the IEP at the college level.

LCC only allows testing in a different format when the limitation is a documented physical limitation, such as cerebral palsy or a hearing impairment. Tutoring at LCC is free to all students, while students at HHS must pay for tutoring. English as a Second Language courses are not available at HHS, but are offered at LCC. Both institutions allow students to bring laptops into classrooms. However, HHS will provide a paraprofessional or a special education teacher for students, where such assistance is not available at LCC. Neither LCC nor HHS

provides a separate curriculum for students with disabilities desiring a degree or diploma.

Results

Twenty-five students with disabilities who were graduates of HHS and other area high schools participated in the Bridges Project. Their participation included enrollment in a college success class focusing on the development of self-determination/self-advocacy skills and continuing career exploration taught by members of the Bridges team. Core components of the course included student construction of a self-advocacy plan and presentation of the plan to faculty. As a final activity students were required to develop a disabilities workshop describing characteristics of college students with disabilities and classroom accommodations necessary for their learning. The workshop was advertised through LCC's Center for Teaching Excellence and offered to college instructors and administrators as an optional professional development activity. For elective credit, the college success course was offered in the fall semester of years two and three of the project (2001-03). During the winter semester and subsequent semester, students met two or three times with the college disabilities counselor, the project director, and their rehabilitation counselor for continuing support and career counseling.

All of the students had chosen careers in a scientific or technical field when they enrolled in the project, but many changed their career goals after further investigation. Students were required to interview someone employed in their career interest area and spend a few hours observing that person on the job, as well as to research the career regarding required education and training, salary range, and future employment demand. Through this process 20 students clarified and revised their career goals, and five ended the process undecided (see **Table 1** for a listing of their career interests). At the end of the project, 22 of the 25 students were still enrolled in college. Of the three who discontinued their college program, one joined the military, one relocated to another state, and one opted for full-time work.

In their final evaluation of the college success class and the Bridges Project, all students reported that the project was helpful. The majority of students (90%) were better able to define self-determination, and 80% could more fully explain self-advocacy. Seventy-

Table 1. Career Interests of Bridges Students ($n = 25$)

Career Interest	Number of Students
Media technology	3
Architectural design	2
Web design	2
Graphic design	2
Computer network engineering	2
Nursing	2
Special education	2
Veterinary technician	1
Food science	1
Mathematics	1
Electrician	1
Flight attendant	1
Undecided	5

five percent reported more confidence in speaking with their college instructors about their need for accommodations, and 80% reported talking with all of their instructors about their needs (Lamb, in press).

Recommendations

Based on student experiences as well as their own teaching experiences, the Bridges team developed a list of recommendations for teachers, administrators, and students with disabilities.

- In high school special education, self-advocacy should be explicitly taught and practiced so students with disabilities are prepared to assume this responsibility at the college level.
- College teachers should include a statement in their syllabus regarding the institution's policy on accommodations and should invite students to meet with them regarding their needs.
- In both settings, teachers should use multiple sensory formats (auditory, visual, and kinesthetic) to maximize learning. The importance of independent learning that is not directly evaluated should be emphasized by instructors in both settings.
- Guided notes of class lectures (such as copies of overheads) should be provided when possible, enhancing the learning of all students, especially

students with disabilities who have limitations in auditory and visual processing and cannot take accurate notes.

- All teachers should expect active engagement and participation as well as accountability from all students. Historically teachers in the early grades have lowered their expectations and diluted the curriculum for students with disabilities, thereby disempowering them as successful learners in both high school and college environments.
- Both secondary-level and college instructors need to provide students with frequent feedback on their performance and opportunities to experience a variety of testing formats. Classroom instruction in both settings should incorporate models, demonstrations, analogies, storytelling, problem-solving, and simulations within teaching methodologies and should use multiple formats for classroom assessment.
- High school administrators and teachers should include students with disabilities in regular and advanced science/mathematics courses that are the foundation for certificates and associate's degrees at the college level.
- In both high schools and colleges, a climate that supports students seeking the assistance they need for academic success should be established.
- Administrators from both the high school and the college should promote postsecondary education for students with disabilities so that they can be employable in a wide range of careers.
- Students should take responsibility for their educational needs by practicing self-advocacy and seeking out their instructors for individual help as needed. Students should use available resources, such as organizers, study guides, and assistive technology.
- Students should develop the habit of studying even when they feel the information is not going to be evaluated. They should develop independent study skills and should monitor and evaluate their own performance.
- In addition, students should anticipate the sequential pattern of science and math curricula and ask clarifying questions as the need arises in class or in meetings with their instructors.

Conclusion

In conclusion, the Bridges Project team identified vast differences in student and instructor expectations and the laws governing both institutions. Based on the student outcomes of the college success class developed by the Bridges Project, the team concluded that self-determination is a key to understanding one's disability and therefore needs to be explicitly encouraged at every level. Self-advocacy is essential in securing accommodations in college. To experience college success that can lead to science careers, students must know how they learn best, be able to self-advocate, and use the necessary tools, resources, and technology. Faculty and administrators in both settings must hold high expectations for students with disabilities and ensure that their institution provides the necessary accommodations to facilitate academic success.

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