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Strategies to Increase Representation of Students with Disabilities in Science, Technology, Engineering and Mathematics (STEM)

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Article Info	ABSTRACT
	As a nation wrestles with the need to train more professionals, persons with disabilities are undereducated and underrepresented in science, technology, engineering, and mathematics (STEM). The following project was proposed to increase representation of students with disabilities in the STEM disciplines. The program emphasizes an integrated program of interventions for college students with disabilities (SwD) majoring in STEM which centers on a system of continuous student monitoring with rapid access to academic and personal services, as well as professional development and degree enhancing experiences supplied during the entire period of college attendance.

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1. INTRODUCTION

*The STEM Landscape in USA***:** Although the proportion of working-age people with disabilities in the U.S. is growing, 9 million are unemployed shown by the U.S. Department of Labor in 2009 [1]. This represents an employment gap of over 40% for persons aged 18-64 whose disabilities would permit gainful employment with available accommodations. The most commonly cited reason for this disparity is inadequate education and training for available positions shown by Bruyère, Erickson, and VanLooy [2].

In 2005, Golshani found that the training and employment gap for persons with disabilities is even wider in STEM fields where increased participation is critical to American competitiveness [3]. In 1998, STEM employment for persons with disabilities is less than half that of the general population published by the National Science Foundation (NSF) [4]. Estimates paint an even bleaker picture for engineering professions where only 1.2% is professional engineers with disabilities compared to 12% in the general population as shown in Stoddard, Jans and Kraus' 1998 studies [5].

Immediate reasons for this disparity are well documented by Izzo and Lamb [6]. Students with disabilities drop out of school at higher rates and have higher absenteeism, lower grades, and more prevalent feelings of low self-esteem. They lag well behind their peers in achievement, graduation rate, post-secondary educational attainment and employment outcomes and have a poorer quality of life overall than their counterparts without disabilities. While recent statistics show a promising increase in the college enrollment rates, many SwD continue to experience limited college success as shown by Stodden and Dowrick [7].

Overall, few Americans with disabilities in the 15-21 age range are prepared to face the demands of the STEM workforce [8]-[9].

Similar to the national picture, SwD are underrepresented in STEM academic programs at University of Louisiana, Lafayette (ULL). As noted by the Louisiana Board of Regents, at the beginning of the 2008-2009 academic year, students registered with the Office of Disability Services (ODS) made up approximately 3.7% of all undergraduate and graduate students enrolled in STEM programs [10]. More than 7% of the SwD registered with ODS, dropped out of school or transferred to non-STEM program. The attritrition rates at ULL have been consistent for the last three academic years. It should also be noted that as with many universities, the actual number of SwD on campus can frequently be underreported.

2.   THE UL LAFAYETTE STUDENT-CENTERED INITIATIVES

The following is a discussion of the specific interventions that are proposed:

2.1. STEM-SwD Transition Program:

The STEM-SwD Transition Program includes three unique initiatives: (a) dissemination, (b) summer transition, and (c) "Fresh Start" programs.

2.1.1. The Dissemination Program

The Transition Specialist's (TS) main responsibility is to make initial contact with the counselors at the secondary schools of the eight surrounding parishes of ULL. A proposed total of 1,800 miles per semester will be traveled by the TS to contact and remain connected with the Counselors and Administration of the public, private, and parochial schools. The TS will participate in administrative transition meetings with the goal of identifying potential Project students while educating them on the importance of STEM majors.

2.1.2. STEM-SwD Summer Transition Program

The STEM-SwD program will implement a summer component for approximately 10 STEM-SwD program students. These students will be selected from the group of students who are admitted to the University either as regular admits or as an Admission by Committee (those students who do not meet the regular admissions requirements). Funds from the STEM-SwD will sponsor these students to attend summer school by covering all expenses for housing, tuition, and books and supplies for. Listed below are the activities for the summer component.Students will take both a STEM course and an Academic Skills course during the semesters.

The STEM course will have support through specialized tutoring and advising throughout the summer. The Academic Skills course is also important because it addresses learning styles, study skills, test-taking skills as well as help the student understand the structure and organization of the university; therefore, providing assistance in navigating the university community. Students will have additional academic support by meeting with the departmental STEM-SwD liaison to discuss additional academic concerns or issues related to the course and/or the major.

2.1.3. Fresh Start Program

There is a need at ULL to establish a program to better prepare SwD coming from high schools into post-secondary education. High schools will be informed of the Fresh Start Program at ULL for SwD who are majoring in STEM majors to help in their adjustment and orientation to college life. This transition program would be offered three days prior to the beginning of classes.Students with disabilities come to college at a disadvantage. The adjustment to college is stressful and confusing to all students. However, for the students who are lacking organizational skills, who experience an emotional disability, who have a learning disability, attention deficit disorder, and/or who have a physical disability, the arrival to college life can be totally overwhelming. Often these students start out with bad experiences and never quite make the adjustment. They end up dropping out the first or second semester feeling like failures or feeling that they just do not belong. The "Fresh Start" Program detailed below would alleviate college adjustment problems common to SwD, evaluate learning strategies, orient students to the library, review organizational techniques/time and stress management, explain financial aid eligibility, and campus layout.

2.2. STEM-SwD Specialized Tutoring Services:

The Learning Center at ULLcurrently offers tutoring to all students. Several tutors meet with students in a large room that is over-crowded and distracting. Students with some disabilities cannot concentrate with such distractions. SwD must have one-on-one tutoring and must require tutors to have disability sensitivity training and training in tutoring techniques unique to students with learning disabilities

in order for tutors to understand how to work with students who have a variety of disabilities. The ULLtutoring service only allows students three, thirty minute sessions per week per subject. SwD have much greater tutoring needs.

The Project will implement a tutoring component which will provide the specialized type of tutoring that students with disabilities need to achieve in the traditionally high fail and drop rate classes of mathematics, computer science, biology, chemistry, engineering, and other STEM specific classes. The tutoring component will ensure that the tutors are educated on ways that are proven to assist students with a variety of disabilities. Training and coaching from a professional contractor in these areas will help to guarantee that the tutors are well equipped with the tools needed to best tutor Project students.

2.3. Ability Specialist: Specialized Advising to Provide Individualized Counseling for Personal, Career, Financial Aid and Academic Matters

Research has shown that individualized attention and availability to assist students with personal issues, career and major decision-making, financial aid processes, and academic concerns result in higher persistence and retention rates. This is especially true for at-risk populations particularly students who are SwD and who do not have the skills to navigate through a university system. Financial aid is especially a major hurdle for SwD. Providing informational workshops and individual sessions regarding the process and procedure of the financial aid application process and funds available to SwD at the local, state, and national levels in terms of grants, loans, and scholarships, will be implemented to help SwD meet their financial need to pursue post-secondary education.

A SwD "ability" specialist will employ intrusive advising as a means of intervention strategies.Intrusive advisors start from the premise that most students do no know what they need in order to finish college and that the advisor must step in to direct through the various offices and services available to them, to help them along. A premise of intrusive advising is that many students do no self-refer and are therefore not only not aware that they are in need of assistance but also do not know of any services that might help them. Intrusive advising uses assertive, proactive measures in contacting students instead of the more traditional and passive method of waiting for student to initiate an advisory meeting. Research has shown that this method of proactive advising has been found to be effective in increasing the retention and overall academic performance of a variety of high risk special student populations.

Dominant retention theories in higher education tend to adopt a social integration position. The key to retention and academic success as noted by Tinto is the development of a sense of connection with the institution [11]. Students in the STEM-SwD will have ample opportunity to make that connection – one of which is through the "ability" specialist. Students participating with the specialized advising activities of the AS will be in a position reaping the benefits of these activities while connecting with a significant person on campus.

2.4. Student Learning Communities (SLC):

The SLCs are initially focusing on college students participating as *scholars*. There are two levels of SLC being organized:

2.4.1. Level I SLC

Student Learning Communities will be established by coordinating students' schedules so that they share one to three classes per semester. This will enable students to connect with the same students sharing the same experiences in the same classes. Students will also coordinate their tutoring schedules in order to share the tutoring aspect.

2.4.2. Level II SLC

A mandatory extracurricular upper class scholars meeting held throughout the academic year. This SLC will address a variety of topics of interest to the group. It will include exploration of post graduation plans (job market entry, graduate school, etc.), interviewing, visits to STEM industries, government agencies (labs), presentations on issues of general science and engineering interest (colloquia, seminars), etc. The level II meetings will comprise the primary group interaction component of the ULL scholars program.Student Learning Communities will assist in providing academic and personal support for SwD attempting similar – if not the exact same – courses and will provide an opportunity for these students to make a connection not only to students in the same areas of interest, but will also provide the opportunity for the students to make a connection to the university. Increased retention in the STEM majors and in progressing toward the degree is an expected outcome of this activity.

3.   EVALUATION

3.1. Mentoring Program

First year ULL scholars will be provided with mentors (upper class and graduate students in STEM). Similar opportunities will be offered to high school students. In a majority of these cases, mentors will also be SwD. ULL upper class scholars will be offered faculty and/or professional mentors as well as the opportunity to be a mentor to new students. Face-to-face mentoring will be the primary mode of communication supplemented by email and telephone interactions as deemed most desirable by the mentor-mentee pairs. The mentoring relationships will be monitored by the Project Director and/or other ULL staff and faculty.The Mentoring Program will provide yet another opportunity for SwD to connect with the university. This opportunity will be with students in the same field of study and who is in the upper class courses; thus providing students with "lessons learned" from someone who has already gone through much of the coursework. Personal and academic support will be gleaned from this relationship as well as a sense of camaraderie.

3.2. Coordination with Other Programs for SwD

The Project plan includes coordinating with other ULL programs and student organizations who work with students with disabilities to include: TRIO programs through theDepartment of Education (Student Support Services, Upward Bound, Veteran's Upward Bound, and Ronald McNair program); Veteran's Affairs; Beacon Club; and Delta Alpha Pi International Honor Society.The Project will work in close communication and will coordinate services with these programs/organizations in order to best meet the needs of as many students as possible. TheProject will keep intentional, consistent communication between the Project and the SSS program, Upward Bound, and Veteran's Upward Bound will be in place to assist in continuingsuccessful services to grant participants from one project to the next, as well as educating Project students to the possible upper-level opportunities presented by the Ronald McNair program.

4.   FUTURE PLAN AND CONCLUSION

Appreciating the importance of objective external evaluation is a key success of this project. The evaluation plan will be *mixed-methods design* with individual and group interviews, surveys, and data base information. Since the potential burden on participants is large the evaluators will be judicious in implementing the evaluation. They also recognize that the demands of integrating data into a meaningful set of cohesive findings will increase as indicated by Altschuld and Witkin [12]. To attribute outcome to intervention is difficult with some attribution resulting from detailed analyses of the database and some from thought-provoking group interview questions.

To achieve efficiencies, the evaluation team will develop a database of students involved throughout the project. The evaluators will link these data to other retention baseline sources which can be compared to other SwD and similarly underrepresented groups such as those included in the Ohio STEM Ability Alliance, Ohio Science and Engineering Alliance, or the National Longitudinal Transition Study [13]-[15].Aside from background variables the evaluation team will collect perceptions via periodic electronic surveys for students, faculty, and staff and conduct interviews and observations. Surveys will deal with the quality and utility of activities and assistance.

ULL College of Engineering was successful in increasing its diable students substantially after implementing this plan. Using constant new student monitoring the retention has increased and more disable students are in line to graduate.

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