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A multifaceted approach to supporting STEM/SBE students with learning disabilities: Highlights of engineering student participants

Consuelo Kreider¹, Anthony Delisle², Mei-Fang Lan³, Sharon Medina², James Gorske⁴, Chang-Yu Wu⁵, Susan Percival⁶, Charles E. Byrd⁷, and William Mann¹

¹Dept. of Occupational Therapy, University of Florida ²Dept. of Health Education and Behavior, University of Florida ³Counseling and Wellness Center, University of Florida ⁴Disability Resource Center, University of Florida ⁵Engineering School of Sustainable Infrastructure and Environment, University of Florida ⁶Food Science and Human Nutrition Dept., University of Florida ⁷Center for Assessment, Strategic Planning, Evaluation and Research

Introduction

Learning disability (LD) is a group of disorders that can negatively impact learning, speaking, listening, thinking, reading, writing, spelling and/or computing [1]. For example, the most common learning disability is in the area of reading, also known as dyslexia. About 6-8% of students in higher education have a disability, of which 46-61% are associated with learning and learning-related disabilities [2]. The University of Florida (UF), like other educational institutions, embraces the challenge of fully accommodating the needs of students with LD to support their academic and personal success. At UF, about 2.6% of the student population self-identifies with a disability and has formally requested support from UF's Disability Resource Center (DRC). Among these students, 31% are diagnosed with Attention Deficit/Hyperactivity Disorder (ADHD) and 23% have a diagnosed learning disorder. By college classification, engineering students account for 19% of this population, the second largest group at UF. Students with LD often struggle academically because they learn differently than other students, and because classroom information is traditionally delivered in ways that do not always match their needs or learning styles. Students with LD also have to combat misunderstanding and negative perceptions from instructors, classmates and even family members, thus negatively impacting their self-perception and social life. The graduation rate best illustrates the outcomes of such challenges - only 15% of college students with LD graduate with an academic degree, compared to 56% of those without a diagnosed disability [3]. However, many people with LD can (and do) have a successful career if their needs are accommodated and their talents are nurtured. Leonardo da Vinci, Louis Pasteur, Albert Einstein, Thomas Edison, Alexander Bell, and William Hewlett are great examples of successful scientists and engineers with suspected and/or diagnosed LD [4, 5].

This paper describes the multifaceted model developed at UF to support students with LD in enhancing their academic achievement and professional acumen within the STEM/SBE

fields (Science, Technology, Engineering, and Mathematics/Social, Behavioral, and Economic Sciences). Case studies of “Engineering Scholars” participating in the program are specifically highlights.

Research Problem

Students’ self-efficacy is pivotal in enhancing motivation and achievement, and life skills are important factors that influence positive academic outcomes encompassing grades, absenteeism, and graduation rates [6-9]. College students with LD have more difficulty with essential life skills, such as time management, coping with stress, problem solving, and communicating their needs to others [10]. Thus, a support system tailored to the needs of STEM/SBE students with LD to improve their academic success through fostering self-efficacy is imperative. We hypothesize that by enhancing essential skills, self-efficacy, and self-advocacy at personal and interpersonal levels, while leveraging existing institutional services, these students will have improved academic experiences.

Methods

Design: Model/Program Overview

The Comprehensive Support for STEM/SBE Students with Learning Disability (CS3LD) program was developed to enhance the personal, academic, and professional development and achievement of undergraduate students with LD enrolled in the STEM/SBE fields (referred to hereafter as Scholars). The CS3LD follows a socio-eco-psychological model designed to simultaneously address personal, interpersonal, and institutional factors that impact personal and academic outcomes of students with LD, while creating a comprehensive structure for supporting their overall academic and personal/health development. Consistent with Social Cognitive Theory [11], which considers a student's self-efficacy to be foundational for motivation and accomplishment, CS3LD activities are designed to increase the student's self-efficacy through improving interpersonal skills, self-advocacy, and knowledge about LD. The CS3LD model concurrently fosters such interpersonal relationships while leveraging existing institutional supports. Traditional models typically address factors impacting students with LD in isolation.

The personal, interpersonal and institutional level objectives targeted by the CS3LD project are as follows:

1. *Personal:* Create mechanisms for CS3LD scholar engagement to foster self-advocacy, self-efficacy, and increased campus connection and participation that will bolster academic satisfaction and success.
2. *Interpersonal:* Create multi-disciplinary mentorship teams for each CS3LD scholar to improve mentoring and professional enculturation to STEM/SBE disciplines.
3. *Institutional:* Create a campus-wide network of health and STEM/SBE faculty, staff, graduate students, and academic

units knowledgeable and coordinated in facilitating success of undergraduate STEM/SBE students with LD.

Project Activities

Three levels of activities have been created to meet CS3LD project objectives. At the *personal* level, Scholars are treated as a cohort and become part of a learning community. They meet monthly as a group to receive LD-related trainings such as “Understanding LD” and “Time Management.” They also work in small groups to create or enhance LD educational materials, such as public service announcements, tips for succeeding in STEM/SBE with LD, and informational brochures. They are also placed in working groups to film a video project designed to inform the university community about LD. Having Scholars involved in the creation of LD educational materials provides a means for enhancing self-advocacy.

At the *interpersonal* level, Scholars are paired with a graduate student mentor in a related field of study. These mentors are provided with training in LD and mentorship. Scholars meet twice monthly with their graduate student mentor for the purpose of professional development and enculturation into the Scholar's chosen STEM/SBE field. They are also paired with a faculty member in their field who can act as that mentor's “go to” person with concerns related to academic progression, professional development, or mentorship within the STEM/SBE field.

At the *institutional* level, the CS3LD project is establishing collaborations for improved communication among key academic and student service units on campus for more coordinated and comprehensive supports for LD students by developing a “Partnership Council”. Made up of administrators from STEM/SBE colleges, academic and health/wellness student services, and representatives from the Scholar and graduate student cohorts, the focus of the Partnership Council is to raise awareness of LD related concerns on campus, identify areas for institutional level change in supporting students with LD, and strategize for how to create such changes.

Analysis/Testing the Model

CS3LD is fundamentally a proof-of-concept project testing a multi-level, cross-disciplinary model for support of undergraduate students with LD. Through implementation of a Continuous Improvement Model (CIM), a quality-based approach often used within educational settings, CS3LD uses an ongoing loop of evaluation and assessment, feedback and appraisal, and modification of project-related activities. Implementation of the CIM has enabled the project investigators to use both formal (e.g., surveys) and informal (e.g., meetings with scholars) techniques to guide incremental changes to planned and ongoing CS3LD activities.

Results

Participants

Following UF's Institutional Review Board approval, 15 Scholars with LD and/or attention disorders were recruited using broad-based recruitment efforts, of which three were in the engineering field. Once Scholars were recruited, 15 graduate mentors, matched to each Scholar based on field of study, were also recruited. A total of 12 (out of 15 targeted) faculty mentors were recruited with assistance of the graduate mentors. The CS3LD project obtained written informed consent from each participant before they engaged in project activities and data collection. Table 1 shows details regarding CS3LD project participants in the Engineering field.

Thirteen of 15 Scholars completed participation in Scholar cohort meetings and individual mentorship throughout the Fall and Spring semesters, of which two were engineering students. The graduate student mentors received LD and mentorship training during the Fall 2013 semester, and prior to beginning meetings with their mentees. Pre- and post-training knowledge assessments were completed for the mentors. Mentor/Scholar pairs sought to meet bi-weekly, which led to a variety of opportunities for Scholars and Mentors to work together. For example, one pair participated in a service activity together, and another pair attended seminars and thesis presentations in their department together. Multiple Scholars worked with their mentors to identify and define professional goals. For instance, one scholar located a research opportunity after receiving encouragement from his/her mentor to do so.

Feedback from the Scholars illustrated how the mentorship activities had informed their professional understanding and options. For example: "Mine's been really good for ... helping me know or at least trying to evaluate ... where I'm going with this, [be]cause I feel like... I don't know what I'm doing with my life, am I choosing the right major? But she's ... giving me some information ... [about] if I continue down this path [and] how it's going to go...I feel like it's made me feel a little bit better..."

Case Studies of Engineering Scholars

This section describes the two undergraduate engineering students enrolled in the CS3LD project throughout the entire Fall and Spring semesters. The first student, referred to as Scholar 1 (S1), was a digital arts and sciences engineering major. In discussing S1's understanding of LD, S1 explained, "I think people with LDs are people who think outside the box." As a freshman, S1 took a psychology course that presented new and various challenges in the way S1 comprehended information. While enrolled in the psychology course, S1 was unable to retain and understand the unfamiliar verbal information. After noticing that these symptoms persisted throughout the freshman year, S1 decided to get tested for LD and was subsequently diagnosed with dyslexia. During the process of being diagnosed, S1 realized that to learn effectively, there was a need to learn concepts, theories, and verbal input by visualizing them. S1 used YouTube videos as a study tool to help visually understand class material, especially in mathematics. By placing the YouTube video

on mute, S1 could focus on watching the problem being solved. By learning new math concepts in this way, S1 was able to quickly understand the mathematics procedures.

Within the engineering field, the ability to visualize information was a strength that S1 implemented when working on teams. S1 described team projects as the best learning style for S1's needs. While S1's classmates offered a different perspective when working on engineering projects, S1 was able to help them visualize information and propose creative solutions. For instance, S1 explained difficult aspects of a problem by breaking it down into simpler pieces. S1 was then able to draw out the steps so that others could understand. "I take this (LD) as a strategy. I know that I can see things that they can't and sometimes they can see things that I can't. I am able to visualize things they cannot. So I make my disadvantage into an actual advantage." S1 enjoyed offering different perspectives and solutions to peers when working on assignments and projects; S1 viewed this as a significant asset afforded by the LD.

The second student, referred to as Scholar 2 (S2), was a mechanical and aerospace engineering student. S2 had a long-standing interest in light and how objects are built. These dual interests sparked S2's interest in becoming a double engineering major. After attending a small college, S2 transferred to UF, a large research-intensive university. When first arriving at UF, S2 had difficulty learning the material being covered in the classes. S2 also had significant difficulty learning in large lecture halls, which often contained over one hundred students. During the time that S2 was having difficulty with classes, S2 expressed concerns to the engineering academic advisor. This advisor suggested that S2 get tested for an LD. After diagnosis, S2 registered with the DRC where they helped S2 learn strategies designed to help with classroom success. S2 benefited from having extra time to complete exams. S2 also used the academic accommodation that enabled S2 to take a lighter course load. The reduced course load accommodation can be especially helpful for students with LD who have both slower reading and slower information processing.

When S2 experienced difficulty understanding class material, S2 actively sought help from professors. When approaching professors for assistance, S2 explained to them that in order for S2 to fully understand the material, S2 must know the meaning or the concept behind the problem. As stated by S2: "I learn when I can practically apply things, like [in] projects. When a professor [tells me] there is no project you can do for this [concept], I ... [ask the professor to] help me physically understand what we are doing [learning]..., help me understand what this *variable represents*." S2 advocated for S2's needs as an engineering student by enabling engineering professors to understand what S2's needs were as a student with LD.

Discussion

Impact on the Engineering Scholars

Within their engineering education, Scholars 1 and 2 both felt that hands-on projects were better suited to their learning styles. Engineering professors who helped simplify abstract concepts, as well as difficult math problems, were the most helpful to both Scholars. Both Scholars attributed their strengths in problem solving and creative thinking to their success

as engineering students. These attributes have been characterized as strengths in individuals with dyslexia [12]. Additionally, both Scholars attributed the practical and hands-on aspects of engineering as important for their success as engineering students. This too, is consistent with literature describing highly intelligent students with LD to more easily learn information through their physical senses (as opposed to visually watching or listening to new information) [12].

Both engineering Scholars regularly attended and actively participated in the scheduled Scholar Cohort meetings. During the meetings both Scholars repeatedly voiced appreciation of their CS3LD project participation, which included individual mentoring, group meetings, guest presentations, and a variety of projects. However, only S1 met regularly with the graduate student mentor – thus receiving the benefit of the mentor's guidance for professional development. S1 met with the mentor 12 times throughout the Fall and Spring semesters, with meetings lasting primarily 20-40 minutes. These meetings focused on S2's academic concerns (12/12 meetings), professional skills (9/12 meetings), STEM related questions (7/12 meetings), self-efficacy (4/12 meetings) and other topics, such as the importance of developing a consistent reading habit (3/12 meetings). S2 met with the mentor only twice in the Fall semester. During those meetings, the mentor served primarily as a professional and academic resource for him. S2 had difficulty keeping scheduled mentorship meetings due to activities associated with courses (e.g. group projects, assignment due dates). Despite differences in the mentor-related activities, both Scholars felt that their participation had positively impacted their perspective about their LD. Similar to the way S1 enjoyed gaining knowledge and confidence about LD, S2 enjoyed having a voice in the project. S2 felt that the CS3LD project offers a solution for students with LD pursuing post-secondary STEM education.

Initial Dissemination

As promoting awareness of LD is an important element of the project, the CS3LD project has been successful in disseminating preliminary and introductory information about this program. The CS3LD project has developed and maintained a comprehensive project website containing multiple resource pages on LD for students, mentors, faculty, and the general public. Project activities and involvement information can also be found on the website. In addition to the website, the project was the focus of five newspaper articles and television news reports. The project has also been featured on a list with other NSF RDE (Research in Disability)-funded programs. This connection has facilitated CS3LD's integration into the network of NSF RDE-funded programs and promoted connections with other RDE projects across the country.

Future Directions

Recommendations from graduate student mentors included (1) allowing for trainings to be more interactive, (2) providing more tips on how to work with the mentee and what to expect in their meetings with them, and (3) expanding on what symptoms to expect with different LD diagnoses. The CS3LD team will use this feedback to modify the existing training modules and create new trainings that provide more information regarding tips and symptoms of different LD diagnoses.

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References

1. NCLD.. Learning Disability Fast Facts. Sep 21. 2014 Available: <http://ncld.org/types-learning-disabilities/what-is-ld/learning-disability-fast-facts>
2. Murray C, Goldstein DE, Nourse S, Edgar E. The postsecondary school attendance and completion rates of high school graduates with learning disabilities. *Learn. Disabil. Res. Pract.* 2000; 15:119–127.
3. Quick D, Lehmann J, Deniston T. Opening doors for students with disabilities on community college campuses: What have we learned? What do we still need to know? *Community Coll. J. Res. Pract.* 2003; 27:815–827.
4. in-spite-of.org. Famous people with learning disabilities. Sep 29. 2011 Available: http://www.vmi.edu/uploadedfiles/academics/academic_support/disabilities_services/famous%20people%20with%20learning%20disabilities%20-%20updated.pdf
5. Love, D. 15 CEOs With Learning Disabilities. Oct 2. 2011 Available: <http://www.businessinsider.com/ceo-learning-disabilities-2011-5?op=1>
6. Chemers MM, Hu L-T, Garcia BF. Academic self-efficacy and first year college student performance and adjustment. *J. Educ. Psychol.* 2001; 93:55.
7. Kennett DJ, Keefer K. Impact of learned resourcefulness and theories of intelligence on academic achievement of university students: An integrated approach. *Educ. Psychol.* 2006; 26:441–457.
8. Perry RP, Hladkyj S, Pekrun RH, Clifton RA, Chipperfield JG. Perceived academic control and failure in college students: A three-year study of scholastic attainment. *Res. Higher Educ.* 2005; 46:535–569.
9. Zajacova A, Lynch SM, Espenshade TJ. Self-efficacy, stress, and academic success in college. *Res. Higher Educ.* 2005; 46:677–706.
10. Reiff HB, Hatzes NM, Bramel MH, Gibbon T. The relation of LD and gender with emotional intelligence in college students. *J. Learn. Disabil.* 2001; 34:66–78. [PubMed: 15497273]
11. Bandura, A. Self-efficacy : the exercise of control. W.H. Freeman; New York: 1997.
12. LaFrance EDB. The gifted/dyslexic child: Characterizing and addressing strengths and weaknesses. *Ann. Dyslexia.* 1997; 47:163–182.

Table 1

CS3LD Project Engineering Participants and Mentorship Pairings

Scholars' Major	Graduate Student Mentor's Field of Study	Faculty Mentor's Academic Field
Digital Arts and Sciences Engineering	Computer Engineering	Electrical & Computer Engineering
Chemical Engineering	Chemical Engineering	<i>no faculty mentor recruited</i>
Mechanical and Aerospace Engineering dual major	Mechanical Engineering	Mechanical Engineering