Using Student Learning Communities to Recruit STEM Students with Disabilities

Margaretha Vreeburg Izzo
Alexa Murray
Sarah Priest
Bianca McArrell
The Ohio State University Nisonger Center

Abstract

Student Learning Communities (SLCs) for high school and college students with disabilities interested in pursuing science, technology, engineering, and mathematics (STEM) degrees were piloted at a major Midwestern university from 2009 to 2011. Students participated in a series of weekly sessions and/or a residential campus experience as part of a multifaceted intervention that included instruction on transition, self-determination, and self-advocacy skills. These activities culminated in the development of customized Self-Advocacy Plans and Transition Portfolios that students presented as their final project for the SLCs. Survey results from a formative evaluation process reveal that students gave high ratings to the development of Self-Advocacy Plans and Transition Portfolios as well as networking with other students with disabilities who are interested in STEM. The majority of students who participated in the STEM-focused SLCs were admitted to STEM degree programs at the undergraduate or graduate levels. These findings suggest the value of providing SLCs to teach self-determination, self-advocacy, and career development skills to students with disabilities, especially for students interested in STEM careers.

Keywords: Transition, STEM, learning communities, self-advocacy, twenty-first century workforce

As the nation wrestles with the need to train more STEM professionals, persons with disabilities are undereducated and underrepresented in STEM disciplines. National statistics on the science and engineering workforce show that only about 7% of graduate students in science and engineering were persons with disabilities (as of 2004, the latest year available) (Sevo, 2011). The most commonly cited reason for the disparity between STEM graduates with and without disabilities is inadequate education and training for available positions (Bruyere, 2000). Numerous researchers have cited the gap in enrollment and persistence in postsecondary education between students with and without disabilities (Kochhar-Bryant, Bassett, & Webb, 2009; Newman, Wagner, Cameto, Knokey & Shaver, 2010). While 63% of students without disabilities enroll in postsecondary education, only 46% of students with disabilities enroll (Newman et al., 2010). In regards to degree attainment, according to a 2003 Government Accountability Office report, only 16% of students with disabilities complete a bachelor's degree program as opposed to 52% of their non-disabled peers (U.S. Government Accountability Office, 2003).

Moreover, when examining 2005 cohort data from the National Longitudinal Transition Study 2 (NLTS2), 18% of students with disabilities who left their postsecondary program actually left because they graduated. This number has remained relatively stable over time, as it was 17% in 1990 when the first NLTS was conducted. An implication of this statistic is that when students leave college, few are leaving because they are completing their programs and earning degrees (Newman et al., 2010). When students with disabilities do complete their degree programs, they tend to take longer than the general student population and frequently report feeling alienated from mainstream campus life (Brinckerhoff, McGuire, & Shaw, 2002; Rumrill, 2001).

Students with disabilities in two-year colleges also face challenges as they transition to four-year schools. Some are similar to those faced by their non-disabled peers, such as changes in academic requirements, poor

study skills, and inadequate financial support. Some challenges, however, are related to disability or a lack of self-advocacy skills. Another challenge is the difficulty in adjusting to the differences in the offices for disability services between the two types of schools (Burgstahler, Crawford, & Acosta, 2001). Clearly, obtaining two-year or four-year college degrees continues to be a significant challenge for many students with disabilities.

Considering the gap for students with disabilities pursuing higher education degrees, the gap for training and employment for persons with disabilities is even wider in STEM fields where increased participation is critical to American competitiveness (Golshani, 2005). The unique challenges faced by students with disabilities in STEM are complex. In postsecondary education, students face barriers to access. In order to receive accommodations, students must disclose having a disability and request accommodations—a process often laden with social stigma. Sevo (2011) observes that higher education institutions are willing to make physical accommodations for students with disabilities, but creating a welcoming climate, as evidenced by faculty who maintain high performance expectations while encouraging students with disabilities to use accommodations, has yet to follow suit. Often students with disabilities resist requesting accommodations due to poor societal perceptions of people with disabilities (May & Stone, 2010). Students are often met with negative attitudes from faculty and peers or are altogether discouraged from pursuing STEM degrees. In a study on the perceptions of parents and teachers on students with learning disabilities entering science and engineering fields, both parents and teachers had the perception that counselors, teachers, and parents do not encourage students with learning disabilities to take courses in science and engineering (Alston, Bell, & Hampton, 2002).

To face these challenges, numerous researchers have identified evidence-based practices to improve postsecondary outcomes of students with disabilities, such as providing transition programs to increase self-advocacy and self-determination skills (Baer et al., 2003; Benitez, Lattimore, & Wehmeyer, 2005; Halpern,Yovanoff, Doren & Benz, 1995; Repetto, Webb, Garvan, & Washington, 2002; Wehmeyer & Palmer, 2003; Wehmeyer & Schwarz, 1997). Self-determination is a combination of skills, knowledge, and beliefs that enable a person to engage in goal-directed, self-regulated, and autonomous behaviors (Field, Martin, Miller, Ward, & Wehmeyer, 1998). Embedded in the self-directed planning and execution processes are essential skills related to choice making, problem solving, decision-making, self-regulation, and self-advocacy or leadership (Wehmeyer, 2003).

Many students with disabilities are poorly equipped to request and negotiate accommodations at the postsecondary level due to a lack of opportunity to practice these self-advocacy skills in high school (Grigal & Hart, 2010). Therefore, students who wish to pursue postsecondary education need training and support in the area of self-determination and self-advocacy skills (Thoma & Wehmeyer, 2005). Research suggests that practicing these skills can help students with disabilities succeed in and out of school (Field et al., 1998). Benitez et al. (2005) reported that teaching self-determination skills in high school was positively correlated with improved post-school outcomes.

Wehmeyer and Schwartz (1997) found that students with disabilities who measured higher on measures of self-determination were nearly twice as likely to be employed and have a higher hourly wage one year after high school. In a later study conducted by Wehmeyer and Palmer (2003), self-determination skills in high school were found to be significant predictors of post-school education and independent living success. Without self-determination skills, many students with disabilities do not effectively advocate for the accommodations they need (Izzo & Lamb, 2002). Emphases on helping students with disabilities develop self-determination and self-advocacy skills are in concert with the demands of gaining STEM degrees and careers. We assert that self-advocacy will increase students' ability to navigate the challenges they face in rigorous STEM programs.

Student Learning Communities

Student Learning Communities (SLCs) are one strategy to help STEM students with disabilities develop self-advocacy skills while planning their transition to STEM degrees and careers. The SLCs provide opportunities for skilled professionals to teach these self-determination skills directly to high school and college students with disabilities. These communities can vary depending on the context in which they are implemented but, generally speaking, SLCs are defined as a collection of activities organized by common goals that a group of students complete together (Swaner & Brownell,

2008). An important feature of an SLC is that a cohort of participants is created, which serves as an ongoing social support network. Student Learning Communities are more prominent on college and university campuses in recent years because they can afford concentrated and creative learning through a cost-effective model (Swaner & Brownell, 2008).

Student Learning Communities can lead to a range of positive outcomes—including academic, personal, and civic—for the general population of college students as well as underserved students (Swaner & Brownell, 2008). In a study of 80,479 randomly selected first-year and senior college students across 365 four-year universities implementing SLCs, the results indicated that participation in an SLC was uniformly and positively linked with student academic performance, engagement in educational activities, gains associated with college attendance, and overall satisfaction with the college experience (Zhao & Kuh, 2004). The DO-IT Scholars program at the University of Washington has developed a residential SLC model where high school students with disabilities interested in STEM come to campus in the summer to learn how to navigate a large university, request disability accommodations, get along with roommates, and succeed in college. When students were surveyed on the long-range impact of the program, which included career preparation, peer support, and internship experiences, they reported growth in their level of preparation for college, employment, and self-advocacy skills (Burgstahler, 2003).

Our SLC model builds upon the success of other models and includes an online transition-focused curriculum resulting in a comprehensive Self-Advocacy Plan and Transition Portfolio. Prior to being modified for SLC purposes, our online curriculum was piloted statewide across various high schools and school districts using a pretest-posttest control group design. Through two consecutive U.S. Department of Education grants, a transition-focused curriculum called EnvisionIT was piloted by 600 students with and without disabilities in special education and inclusive classrooms at 15 Ohio high schools during a six-year period. Findings revealed that, when compared to the control group, students in the experimental group made statistically significant gains in several key transition skill areas, including goal setting and knowledge of how to find information about college and jobs (Izzo, Yurick, Nagaraja, & Novak, 2010). Based on these findings, EnvisionIT was used as a valid archetype for our SLC curriculum. Our current SLC curriculum consists of 8-10 units with activities and assessments and is delivered through Ning.com, an accessible and secure social networking website.

Method

Our SLC Model

Currently two STEM-focused SLC models for students with disabilities are being piloted at a major postsecondary Midwestern institution. These models were developed from the review of the literature and serve as key transition scaffolds to success in STEM. These two models are similar in design, but each has a slightly different focus, target population, and desired outcome (see Table 1). One model, called the Beginner SLC, introduces key study and self-advocacy skills and prepares high school and community college students for the transition to college life and STEM majors. The other model, called the Advanced SLC, strengthens self-advocacy skills and prepares undergraduate and graduate students at a four-year institution for the transition to STEM internships and employment. Despite slightly different areas of emphasis, both models provide students with the supports, information, and resources to successfully transition into STEM degree programs and ultimately the STEM workforce.

Curriculum content and delivery is tailored to the instructional needs of SLC participants, but generally both Beginner and Advanced SLC curricula focus on the following core transition areas, which are defined more specifically as follows (see Table 1):

- Self-Awareness: researching interests, learning styles, personality traits, strengths, and challenges
- Self-Determination/Self-Advocacy: understanding disability, disclosure, and how to negotiate for accommodations
- Assistive Technology (AT): learning about AT assessment, identification, and use
- Career Exploration: matching strengths and interests to potential majors and careers
- Networking: creating a support network
- Study Skills: learning time management and organization strategies
- Setting Goals: developing short and long-range goals

Table 1

Comparison of SLC Models and Curricula

	Beginner SLCs	Advanced SCLs
SLC Model & Target Population	Residential or weekly SLC for high school and community college students with disabilities	Weekly SLC for college and graduate students with disabilities
Focus	Students with disabilities transition to college, STEM majors, and internships	Students with disabilities complete STEM degree programs and internships, resulting in transition to STEM workforce
Desired Outome	Students matriculate to two-year or four-year college programs and access needed accommodations as identified in their Self-Advocacy Plans developed through the SLC	Students persist in and graduate from STEM majors and transition to STEM careers and access needed accommodations as identified in their Transition Portfolios developed through the SLC
Curricular Content		
Self-Awareness	Students take self-assessments: • VARK (Learning Styles)www.vark-learn.com/english/page.asp?p=questionnaire • Myers-Briggs (Personality) www.personalitypathways.com/type_inventory.html • Princeton Review (Career Interests) www.princetonreview.com	Students take self-assessments: • VARK (Learning Styles) www.vark-learn.com/english/page.asp?p=questionnaire • Myers-Briggs (Personality) www.personalitypathways.com/type_inventory.html • Princeton Review (Career Interests) www.princetonreview.com
Choice-Making	Students research colleges, compare and contrast colleges and STEM majors, identify college to apply to, and begin application process	Students research and compare and contrast graduate schools and STEM careers, identify graduate schools and employment opportunities to apply to, and begin application process
Assistive Technology	Program staff assess students' AT needs, match appropriate AT to students, pilot selected AT with students, and train students on AT	Program staff assess students' AT needs, match appropriate AT to students, pilot selected AT with students, and train students on AT

(Table 1 continued on next page)

Career Exploration	Students research STEM careers and internships in-depth, match abilities and strengths with careers and internships, and pursue internships	Students research STEM careers and internships in-depth, match abilities and strengths with careers and internships, and pursue internships
Networking	Students build professional relationships with peer group, program staff, support services, and potential internship sites	Students build professional relationships with peer group, faculty, support services, program staff, and potential employers
Study Skills	Students learn essential organization, time management, and learning strategies	Students learn essential organization, time management, and learning strategies
Setting Goals	Students develop long and short term goals related to increasing GPA, applying for college and self-advocating	Students develop long and short term goals related to self-advocating, gaining internships and employment
Internships & Employment	Students learn job-searching techniques, find internships, build resumes, create cover letters, and practice interviewing for jobs	Students enhance job-searching techniques, find internships, build or refine resumes, create cover letters, and practice interviewing for jobs
Disability Issues	Students learn impact of disability on learning as well as student responsibilities with disclosure and requesting accommodations in the college environment	Students learn impact of disability on learning and employment as well as employee responsibilities with disclosure and requesting accommodations in the workplace

- Internships and Employment: searching, applying, writing resumes, and interviewing

Setting

The Beginner SLC is often delivered in a residential format where students stay in a university dorm for four to five days. It allows students to experience college, identify needed accommodations and/or AT supports, network with people with similar interests, and learn essential skills for independence. The Beginner SLC can also be implemented as a weekly class on a college campus in which transition-based instruction, supports, and services are delivered in a class seminar format for a specified academic period (usually about 10 weeks or more with 90-120 minutes of instruction per week). Career development specialists, disability services counselors, assistive technology specialists, and college staff from admissions, student life, and financial aid offices present on a variety of topics ranging from getting into college to selecting a STEM major.

Students have opportunities to gain knowledge about their personal characteristics, strengths, limitations, interests, and skills through personality, interest, and learning style assessments. They learn strategies for selecting colleges and STEM majors, taking essential coursework in STEM, completing college and financial aid applications, and developing resumes and letters of application. Students also can take STEM modules, which are mini-courses in specific STEM concentrations, in order to learn about STEM disciplines in a fun and interactive way. For example, STEM modules in the area of applied cognitive science include (a) artificial intelligence and game playing in which students create strategy games with computer software, (b) brain anatomy and physiology in which students build a brain model and test neuromuscular plasticity, and (c) mental heuristics in which students design interfaces that enhance human problem solving. At the conclusion of the SLC, students present a comprehensive Self-Advocacy Plan and Transition Portfolio, which summarizes their personality and learning style assessments, postsecondary goals for college and employment, and a self-advocacy component that includes a description of how their disability impacts learning and what accommodations are available to enhance learning college material, especially challenging STEM content.

Targeting undergraduate and graduate students majoring in STEM, the Advanced SLC model is implemented as a weekly class on a college campus in which transition-based instruction, supports, and services are delivered in a class seminar format for a specified academic period (usually about 10 weeks or more with 90-120 minutes of instruction per week). The structured format of this SLC engages students in weekly sessions that cover similar topics to those in the Beginner SLC, with more in-depth exploration of self-advocacy, time management and goal setting, resume development, interviewing skills, and leveraging internships. At the conclusion of the Advanced SLC, students develop and present a Self-Advocacy Plan and Transition Portfolio similar in content to the Beginner SLC but with greater emphasis on building resume, internship, and job readiness skills.

When the Advanced SLC ends, students are expected to remain involved in the SLC community by serving as role models and supports for Beginner SLC students. Advanced students participate in the residential summer SLCs for Beginner students and are matched as mentors to Beginner Students. Advanced students also receive mentoring from working professionals in STEM fields. The SLC alumni also support new SLC students through campus tours, field trips to engineering and science labs, panel discussions about selecting STEM majors and classes, and discussions about self-advocacy, including recommendations about when to disclose and when not to disclose one's disability. These activities contribute to establishing and broadening a network among STEM students with disabilities.

Recruitment

Project staff have participated in over 25 recruitment activities to date, including presentations at state conferences, participation in Regional Transition Council meetings, and local transition fairs. High school students recruited for the Beginner SLCs were recruited from 10 different high schools, with no more than three students from any one high school. Participants for the weekly Beginner SLCs were recruited from local high schools and community colleges, whereas participants for the residential Beginner SLCs were recruited from high schools statewide including the Ohio State School for the Blind and Metro High School, a STEM-focused charter school. Letters and emails with SLC applications were posted to websites and sent to principals, teachers, special education directors, rehabilitation counselors, and transition coordinators.

Community college participants were recruited via recruitment fairs, back to school campus events, and referrals from the Department of Disability Services at a local community college. Notably, at this same institution, Beginner participants were also recruited from a unique transition support program for students with Autistic Spectrum Disorders matriculating from high school to college. This program helps students with Autistic Spectrum Disorders with the numerous social and academic adjustments that accompany going to college. Many of these students are interested in pursuing STEM majors and careers, thus creating a natural pipeline for recruitment into our SLC program.

Participants for the Advanced SLCs were undergraduate and graduate students from local four-year postsecondary institutions. These students were often referred by the college campus' office for disability services or equivalent as well as STEM faculty at four-year institutions. Additionally, letters and emails with SLC applications were disseminated to faculty members and administrators across STEM departments, and project staff recruited via back to school campus and mentoring events. State rehabilitation counselors also provided referrals.

Candidates for all SLCs went through a formal application and interview process. Students submitted applications including current career goals and interest in STEM disciplines. Once admitted, qualified students completed an intake process that included face-to-face interviews in order to ascertain functional limitations and learning needs, accommodations and supports used, prior experiences with STEM and transition planning, technological literacy, current coursework and progress in school, and goals. Letters of recommendation were solicited to verify student interest in STEM careers. This intake process helped to create a comprehensive profile of each student so that SLC content and delivery was tailored to the individual needs of those participating. It should be noted that not all high school students who applied to participate in the SLCs were selected. Some were not selected because of not meeting the grade level requirement (must be high school juniors or seniors) and some were not selected because there were no more slots available (for the residential SLC), whereas all candidates who applied to the Advanced SLC were admitted as participants.

Measures

Our measures were iterative because the SLC implementation process itself was iterative and not an outcropping of pre-planned research. Therefore, though we have Cronbach alpha coefficients for our instruments, these measures were developed mainly for the purpose of formative rather than summative assessment so that we could improve the SLC process in the early phases of the project. We revised our measures based on need to match recommended changes in SLC content and delivery, resulting in non-comparable instruments.

The High School SLC Evaluation Survey: Non-Residential. This self-report instrument was administered on the last day of the SLC. It consisted of 24 Likert Scale items (1 to 5 scale with 5 being the highest) that asked students to assess their perceptions of knowledge and benefits gained from the SLC in the areas of STEM, career interest, self-advocacy plans, and social networking. It also was comprised of six open-ended items that asked students to describe the SLC experience to other students not familiar with it, particularly key learning points they would emphasize and recommendations for improvement. Items for this survey were selected based on the learning objectives and content map for the Beginner SLC. Due to the small sample size, the Cronbach alpha coefficient of this instrument was only 0.429.

The High School SLC Evaluation Survey: Residential. This self-report instrument was administered on the last day of the SLC. It consisted of 35 Likert Scale items (1 to 5 scale with 5 being the highest) that asked students to assess their perceptions of knowledge and benefits gained from the SLC in the content areas of STEM, career interest, self-advocacy plans, and social networking. This instrument was patterned after its non-residential counterpart in regards to inclusion of these content areas. The items differed in wording so the instruments were not comparable, especially since coordination and organization questions were added that only pertained to the residential experience. It also was comprised of eight open-ended items that asked students to describe the SLC experience to other students not familiar with it, particularly key learning points they would emphasize and recommendations for improvement. Items for this survey were selected based on the learning objectives and content map for the Beginner SLC. The Cronbach alpha coefficient of this instrument was 0.842.

Diverse Ability University SLC Evaluation Survey: Residential. To enhance our methodology, we developed a new instrument that examines common core constructs across all our SLCs. This instrument was piloted in summer 2011 at a residential Beginner SLC called Diverse Ability University hosted in collaboration with a partnering regional university. This self-report instrument was administered on the last day of the SLC. It consisted of 74 Likert Scale items on a 1 to 4 scale (with 1=not at all, 4=very much) with one open-ended item for a total of 75 items on the survey. The Likert Scale items asked students to evaluate each activity on each day of the residential SLC experience in regards to three perceptual ratings: how informative, useful, and engaging was the activity. Students were also asked to provide global ratings of how much they think they learned because of the SLC in regards to eight common core constructs that will be used as benchmark measures for all our SLCs for the sake of yielding comparison data. These constructs include the following: (1) awareness of learning opportunities and strategies, (2) personal responsibility, (3) time and stress management, (4) engagement, (5) identity as scientists, (6) self-advocacy, (7) self-determination; and (8) intention to persist in STEM. A Cronbach alpha coefficient of these constructs is not available due to the fact there is only item per construct. However, there were also four SLC specific constructs—confidence with hands-on science, relationship building, description of personality types and learning styles, and confidence with transition to college—on which Cronbach alpha coefficients were able to be calculated and are as follows: 0.740, 0.527, 0.730, and 0.546, respectively. Again, small sample size and low number of items per construct yielded modest coefficients.

The Advanced SLC Evaluation Survey. This self-report instrument was administered on the last day of the SLC. It consisted of 35 Likert Scale self-report items (1 to 5 scale with 5 being the highest) that asked students to assess their perceptions of knowledge and benefits gained from the SLC in the areas of STEM, transition planning, self-advocacy, social networking, college survival skills, and available campus resources and supports. It also was comprised of nine open-ended items that asked students to describe key learning points of the SLC that stand out, positive and negative factors, and recommendations for improvement. Items for this survey were selected based on the learning objectives and course syllabi for the Advanced SLC. The Cronbach alpha coefficient of this instrument was 0.733.

Results

Participants

Table 2 provides sample sizes, grade level, gender, and primary disability status of all the SLC participants. Data for the four Beginner SLCs has been aggregated for comparison purposes (N=67). Likewise, data for the two Advanced SLCs has also been aggregated for comparison (N=16). As Table 2 indicates, most of the students were male. The SLC participants identified themselves as having various disabilities, including attention deficit/hyperactivity disorder (ADHD), specific learning disability, sensory impairments, and autistic spectrum disorder. In the Beginner SLC, Autism Spectrum Disorder was the most common disability category (27% of participants), whereas for the Advanced SLC, ADHD was the most common disability category (38%). Regarding race and ethnicity, for the Beginner SLCs, 61% of participants were Caucasian, 32% were African-American, and 7% were Hispanic/Latino. For the Advanced SLCs, 55% of participants were Caucasian, 19% were Hispanic/Latino, 13% were African-American, and 13% were Asian. In regards to GPA, the average GPA for the Beginner SLC participants in 2009-10 was 2.95 and in 2010-11 was 3.01, an increase of .06. For Advanced SLC participants, their 2009-10 average GPA was 2.97 and in 2010-11, their average GPA was 3.12, an increase of .15.

SLC Ratings

Likert Scale Responses. In Table 3, the most highly rated items on a 1 to 5 Likert Scale with 5 being the highest are presented for the three 2009-2010 Beginner and two Advanced SLCs. For the Beginner SLCs, results reveal that knowledge of self-advocacy, disability, academic supports, and campus resources were the most highly rated. Social networking in which students with disabilities interested in STEM are able to have discussions with their own peer group was also highly rated. Participants in the Beginner SLCs rated learning about college highly, whereas participants in the Advanced SLCs rated resume content highly, which is logical given their different points in the transition process. The global satisfaction survey item "would recommend the SLC only with changes" received a mean of 1.70 on a scale where 1 equals strongly disagree and 5 equals strongly agree.

In Table 4, the most highly rated items for the 2011 residential SLC include the constructs of personal re-

Table 2

Characteristics of SLC Student Participants

	Beginner SLCs (N=67)	Advanced SLCs (N=16)
Dates		
	April – May, 2009 (weekly) July, 2010 (residential) August, 2010 (residential) July, 2011 (residential)	December, 2009 – March, 2010 (weekly) March, 2010 – June, 2010 (weekly)
Grade Level		
High School	93% (n=62)	n/a
Community College	7% (n=5)	n/a
Undergraduate	n/a	75% (n=12)
College Graduates*	n/a	25% (n=4)
Gender		
Male	78% (n=52)	87% (n=14)
Female	22% (n=15)	13% (n=2)
Primary Disability		
ASD	27% (n=18)	6% (n=1)
Blind/VI	19% (n=13)	6% (n=1)
ADD/ADHD	16% (n=11)	38% (n=6)
SDD/LD	11% (n=7)	19% (n=3)
Deaf/HoH	12% (n=8)	6% (n=1)
Multiple	4% (n=3)	0% (n=0)
Health	11% (n=7)	19% (n=3)
Grade Point Average		
2009 - 2010	2.95	2.96778
2010 - 2011	3.006211	3.1225

* Includes two graduate students

Table 3

*Highest Rated Results from 2009 - 2010 SLCs**

Beginner SLCs (N=41)	Advanced SLCs (N=16)
1. Learning about academic assistance available on campus (4.73)	1. Enjoyed participating in the SLC (4.60)
2. Discussing with other students with disabilities interested in STEM (4.67)	2. Met others who share interests/concerns (4.50)
3. Understanding accessing Disability Services as support (4.64)	3. Self-Advocacy Plans and accommodations (4.42)
4. Understanding accessing OSAA as support (4.64)	4. Time management content (4.36)
5. Discussing with other OSAA students (4.55)	5. Mentoring content (4.33)
6. Learning about specific services related to fields of study (4.55)	6. As a result of the SLC, considering taking more STEM courses (4.30)
7. Gaining college survival skills (4.47)	7. OSAA Ning site and tutorial (4.30)
8. Learning about college life (4.47)	8. Learned about people to contact with problems and issues (4.20)
9. Felt the learning community was a good experience (4.40)	9. Want to continue contacts made from the SLC (4.20)
10. Producing a meaningful Self-Advocacy Plan (4.30)	10. Resume, cover letter, and personal statement content (3.92)
11. Learning key factors for academic success (4.29)	11. SLC improved my ability to handle stress (3.90)
12. Learning about one's self (4.10)	12. Disability disclosure (3.83)

*Mean results reported. Likert Scale 1 to 5 rating was used with 5 being the highest (1 equals strongly disagree and 5 equals strongly agree).

sponsibility and self-advocacy. Students also reported a high level of confidence with transition to college because of the SLC experience. Once again, self-advocacy seems to be a key skill area in which students reported they obtained knowledge through the SLC process, thus supporting the 2009-2010 survey findings. The global satisfaction item "how satisfied are you with Diverse Ability University?" received a mean of 4.20 on a scale where 1 equals very dissatisfied and 5 equals very satisfied. Most participants (84%) reported that they would recommend this SLC experience to a friend.

Open-Ended Responses. The qualitative data seem to support the quantitative findings. One Beginner SLC student commented, "Under the right environment, you can begin to feel comfortable talking about your disability, and that is what the SLC did." Several Beginner participants commented that the "assignments made them think," and "people were comfortable with discussing disability." Other comments such as "persuade people to sign up," "important to anyone with a disability," and "mature environment aids in character development" provide evidence that Beginner students valued their SLC experience.

Likewise, Advanced SLC participants reported finding the SLC experience meaningful. Several Advanced participants indicated that the SLC process taught them to be more comfortable discussing and disclosing their disability. When asked, "What is the first thing about the Learning Community that stands out?" one Advanced respondent said, "How to let others know about your disability." Another student commented that it is important to learn when not to disclose your disability as well. Additionally, several Advanced students commented positively about the resume content emphasis, with one student saying they appreciated "the focus on improving resumes." Other participants in the Advanced SLC commented more generally on the experience, with one student simply saying, "It was what I was looking for and was helpful."

Themes. When examining the quantitative and qualitative SLC data, certain themes emerged. High student ratings on survey items (see Tables 3 and 4) as well as grouping student responses into categories based on shared topics and perceptions revealed similarities in what students reported that they learned. Generally speaking, across SLCs, students reported that they found developing a customized Self-Advocacy Plan and/or Transition Portfolio to be most helpful in their career development. They also reported valuing the opportunity to socially network with other students with disabilities interested in STEM careers. Students also indicated that the training they received in disability self-awareness, the disability disclosure and accommodations process, and adaptive technologies increased their self-advocacy skills and ability to function independently.

Some of the constructive criticism Beginner SLC participants offered includes feedback on the length of sessions, stating that they were too long (or in some cases, not long enough). Students also offered recommendations for more group activities and interactions. They also recommended a greater emphasis on assistive technology. Several participants in the Advanced SLCs stated that they wanted more assistance with resume building. Additionally, one student recommended a class session on "making academic schedules for ourselves and a daily study plan that includes what my ideal work environment is and how I study best. Also follow up with us on our goals we made." In sum, students collectively recommended session length and content emphasis changes. These changes are currently being applied in order to enhance the SLC experience for all participants.

Discussion

The evaluation results suggest that facilitating SLCs is a promising practice to support the recruitment and retention of qualified students with disabilities into STEM degree programs. High school and community college participants consistently rated the Beginner SLC as a good experience where they produced meaningful self-advocacy plans, became more self-aware of their learning and personality styles, and gained insights into STEM fields of interest. College and graduate students with disabilities who are majoring in STEM reported that, during the Advanced SLC, they produced meaningful self-advocacy plans, learned time management skills, and learned about the importance of internships. They also reported that learning about disclosure of disability and the accommodations process through the SLCs was extremely helpful. Other comments included that learning more about their personality was useful in school and work. The majority of students in the first Advanced SLC commented that developing resumes and interview skills and learning about internships was essential.

Table 4

*Highest Rated Results from 2011 Residential SLC**

Learning Community Common Core Construct (N=26)
1. Personal responsibility (3.79)
2. Self-advocacy (3.67)
3. Time management ability (3.63)
4. Engagement (3.63)
5. Persistence in STEM (3.61)
6. Self-determination (3.54)
7. Awareness of learning opportunities and strategies (3.47)
Diverse Ability University Specific Construct (N=26)
1. Confidence with transition to college (3.68)
2. Description of personality types and learning styles (3.64)
3. Relationship building with counselor and other participants (3.61)
4. Confidence with hands-on science (3.37)

*Mean results reported. Likert Scale 1 to 4 rating was used with 1 being not at all and 4 being a lot. Participants were asked to what extent they increased in the above mentioned areas as a result of participating in Diverse Ability University.

Time spent on this portion of the Advanced SLC was increased with a mock job interview activity added to the SLC syllabus. Additionally, students in both the Beginner and Advanced SLCs reported that discussions with other students who are enrolled in STEM programs were most helpful.

Self-Advocacy

As discussed earlier, both high school and college students reported that one of the most valuable activities completed as part of the SLC process was developing a Self-Advocacy Plan. The Self-Advocacy Plan that SLC participants developed includes numerous activities that support a larger framework of student self-determination. Given that self-advocacy is repeatedly cited as a critical college survival skill (Grigal & Hart, 2010; Kochhar-Bryant, Bassett, & Webb, 2009), the process used to assist students with increasing their self-advocacy knowledge and comfort level is discussed in detail here. Students begin their self-advocacy plan by completing a minimum of three learning style and personality assessments (see Table 1). Students described their learning and personality styles and discussed the relationship between learning and teaching methods. Students become more aware of how they learned and how they could create study strategies to help them learn challenging content. For example, creating small group study sessions, working with a tutor, or outlining texts and readings using software applications may assist students with learning

challenging STEM content. Then students compared and contrasted three careers they were interested in pursuing. They developed a career narrative describing their first career choice, using information gained from career research and assessments. Students described their talents, strengths, and abilities and summarized their long-term goals for entering STEM majors and careers. Finally, they broke their long-term goals down into smaller goals that could be accomplished within a few weeks.

The next section of their Self-Advocacy Plan included a description of their disability and how the disability affected their ability to complete assignments, tests, and papers. This section provided an opportunity for students to describe specific accommodations and study strategies that they needed to be successful in classes. Meetings with disability counselors and academic advisors were facilitated to provide opportunities for students to learn how accommodations are negotiated at a particular postsecondary institution. These meetings allowed students to practice how to negotiate accommodations with faculty or employers.

The final section of the Self-Advocacy Plan asked students to identify their responsibilities as self-advocates. Students identified how often they would meet with their disability counselor and instructors and what actions they would take to manage their own learning. For example, will they ask questions in class, audiotape lectures, use a note-taker or study buddy, request extended time for tests, or meet with instructors?

Both high school and college students reported that the development of their Self-Advocacy Plans was an important feature of our SLC model. Since nearly 56% of college students with disabilities do not disclose that they have a disability and go without formal accommodations (Newman et al., 2010), the need to assist students with their ability to advocate for themselves is evident. It seems that more students with disabilities could be successful in college if they had the self-advocacy skills needed to master rigorous STEM content. Once students have the skills to explain their disabilities, identify accommodations that are likely to mitigate their functional limitations, negotiate their accommodations assertively, and assist in the coordination of those accommodations, they are more likely to gain the quality education and training they deserve (Izzo, Hertzfeld, Simmons-Reed, & Aaron, 2001).

Recruiting and Retaining STEM Students with Disabilities

Recruitment. Initial recruitment of Beginner SLC students has been challenging because each high school has a small population of students with disabilities interested in STEM. So far, the recruitment strategies we have found helpful include a broad sweep of formal and informal education and rehabilitation networks. Successful recruitment strategies include the following: mailing or emailing SLC fliers with application packets to special educators, transition specialists, and science and math teachers; targeted meetings with special educators, transition coordinators and rehabilitation networks; presenting at transition fairs at area high schools or colleges; and presenting at conferences and local, regional, or state transition council meetings. At the college level, based on our experience, recruitment of students for Advanced SLCs has been somewhat less challenging because of existing collaborations among campus units. Successful recruitment strategies for Advanced SLCs include expanding cooperative efforts with disability services and student affairs offices as well as STEM faculty across two- and four-year institutions. However, recruitment at the college level can prove difficult if collaborative working relationships among units are not established. Also, accessing the campus population of students with documented disabilities who do not register with or use disability services is an ongoing challenge because these students are difficult to identify.

In short, getting the word out early through multiple, strategic venues is instrumental to project success. We anticipate that, as our programs continue to deliver the SLC model, the challenging recruitment efforts will become somewhat easier. Schools will begin to recognize the benefits of referring students to the SLC because they see the benefits to the student, such as increased self-advocacy and transition skills as well as an established, expanding network of peers. Once this kind of program notoriety is obtained, we assert that schools will participate in an ongoing basis as well as spread the word to other schools.

Retention. Based on our SLC population, students with disabilities frequently have high academic abilities but need individualized intervention services in other key content or social areas—services that can be difficult to provide in inclusive classrooms. For example, our Beginner SLC students had an average GPA of 2.95 in 2009-10, the first year we began to

track GPA of our participants. In 2010-11, the average GPA increased to 3.01. Advanced students increased their GPA from 2.97 in 2009-10 to 3.1 in 2010-11. These academically successful students can ultimately benefit from the SLC experience by gaining a social and professional network that reinforces interest and achievement in STEM pursuits. This kind of network is critical for student engagement in STEM and can lead to increased numbers of students with disabilities entering and completing STEM degrees and joining the STEM workforce. Of the 21 high school students who participated in the first two Beginner SLCs in 2009 and 2010, 76% were actively involved in our STEM program interventions such as mentoring and SLC alumni participation. Of the 10 high school students who have graduated, six have gone on to enrollment in STEM majors as of Spring 2011. Furthermore, of the 21 undergraduate students who participated in the two Advanced SLCs in 2009-10, 100% have remained actively involved in STEM program interventions. Of the four college graduates who were Advanced SLC participants, two went on to competitive employment while the other two were applying to STEM graduate programs as of Spring 2011.

Study Limitations

These SLC programs and their corresponding measures were iterative. They have emerged as part of an ongoing cycle of program development. We were not able to conduct a rigorous research study because of resource and personnel limitations in the first few years of the project. That is, we were focusing our resources on program development and formative assessments, rather than formal evaluations that use rigorous research methodologies. Students provided input on the SLC process through non-equivalent self-report measures, partly due to the unique format of each SLC requiring different types of questions. Other than conducting content validity reviews and calculating Cronbach's alpha coefficients, psychometric steps to validate the instruments were not applied, again due to personnel limitations. It is recommended that future studies employ more rigorous research methodologies to determine the effects of SLCs on academic performance, persistence in STEM, and successful transition to STEM careers. Also, a greater sample size is needed to validate our measures and conclusions. In spite of our current study limitations, the primary purpose of our SLC model was to deliver an intervention that would enhance the recruitment and retention of students with disabilities interested in STEM. Through the interventions and supports they provide, our findings suggest that our SLC model is, at the very least, a promising practice in this area.

References

Alston, R. J. Bell, T. J., and Hampton, J. L. (2002). Learning disability and career entry into the sciences: A critical analysis of attitudinal factors. *Journal of Career Development, 28*(4) 263-275.

Baer, R. M., Flexer, R. W., Beck, S., Amstutz, N., Hoffman, L., Brothers, J.,….Zechman, C. (2003). A collaborative follow-up study on transition service utilization and post-school out comes, *Career Development for Exceptional Individuals, 26*, 7-25.

Benitez, D. T., Lattimore, J., & Wehmeyer, M. L. (2005). Promoting the involvement of students with emotional and behavioral disorders in career and vocational planning and decision-making: The self-determined career development model. *Behavioral Disorders, 30*, 431-447.

Brinckeroff, L., McGuire, J., & Shaw, S. (2002). *Postsecondary education and transition for students with learning disabilities* (2nd ed.). Austin, TX: Pro-Ed.

Bruyere, S. M. (2000) Civil Rights and Employment Issues of Disability Policy. *Journal of Disability Policy Studies, 11*(1) 18-28.

Burgstahler, S. (2003). Do-IT: Helping students with disabilities transition to college and careers. *National Center on Secondary Education and Transition, 2*(3).

Burgstahler, S., Crawford, L., & Acosta, J. (2001). Transition from two-year to four-year institutions for students with disabilities. *Disability Studies Quarterly, 21*(1).

Field, S., Martin, J., Miller, R., Ward, M., & Wehmeyer, M. (1998). *A practical guide for teaching self-determination.* Reston, VA: Council for Exceptional Children.

Golshani, F. (2005). Putting Ability to Work. *IEEE Multimedia, 12*(3), 1.

Grigal, M. & Hart, D. (2010). Think College: postsecondary education options for students with intellectual disabilities. Baltimore, MD: Paul H. Brookes Publishing Co.

Halpern, A. S., Yovanoff, P., Doren, B. & Benz, M. R. (1995). Predicting participation in postsecondary education for school leavers with disabilities. *Exceptional Children, 62*, 151-164.

Izzo, M. V., Hertzfeld, J. E., Simmons-Reed, E., & Aaron, J. A. (2001). Promising practices: Improving the quality of higher education for students with disabilities. *Disability Studies Quarterly, 21*.

Izzo, M. V., & Lamb, M. (2002). *Self-determination and career development: Skills for successful transitions to postsecondary education and employment.* (White Paper). Retrieved March 23, 2011, from http://www.ncset.hawaii.edu/publications/pdf/self_determination.pdf.

Izzo, M. V., Yurick, A., Nagaraja, H. N., & Novak, J. A. (2010). Effects of a 21st-Century curriculum on students' information technology and transition skills. *Career Development for Exceptional Individuals, 33*(2), 95–105.

Kochhar-Bryant, C., Bassett, D. S., & Webb, K. W. (2009). *Transition to postsecondary education for students with disabilities.* Thousand Oaks, CA: Corwin Press.

May, A. L., and Stone, C. A. (2010). Stereotypes of individuals with learning disabilities: Views of college students with and without learning disabilities. *Journal of Learning Disabilities, 43*(6) 483-499.

Newman, L., Wagner, M., Cameto, R., Knokey, A. M., & Shaver, D. (2010). *Comparisons across time of the outcomes of youth with disabilities up to 4 years after high school. A report of findings from the National Longitudinal Transition Study-2* (NLTS2). Menlo Park, CA: SRI International. Retrieved March 17, 2011, from www.nlts2.org/reports/2010_09/nlts2_report_2010_09_complete.pdf.

Repetto, J. B., Webb, K. W., Garvan, C. W., & Washington, T. (2002). Connecting student outcomes with transition practices in Florida. *Career Development for Exceptional Individuals, 25*, 123-139.

Rumrill, P. (2001). Contemporary issues in postsecondary education for students with disabilities: Roles and responsibilities for educators and rehabilitation professionals. *Journal of Vocational Rehabilitation, 16*, 133-144.

Sevo, R. (2011). *Basics about disabilities and science and engineering education*. Under the direction of Robert L. Todd, Center for Assistive Technology and Environmental Access, Georgia Institute of Technology, Atlanta, GA. Retrieved March 12, 2011, from http://stores.lulu.com/sevo.

Swaner, L. E., & Brownell, J. E. (2008). *Outcomes of high impact practices for underserved students: A review of the literature*. Washington, DC: Association of American Colleges and Universities. Retrieved March 17, 2011, from www.aacu.org/inclusive_excellence/Research.cfm.

Thoma, C. A., & Wehmeyer, M. L. (2005). Self-determination and the transition to postsecondary education. In E. E. Getzel & P. Wehman (Eds.), *Going to college*, pp. 49-68. Baltimore: Paul H. Brookes.

U.S. Government Accountability Office. (2003). *College completion: Additional efforts could help education with its completion goals* (GAO-03-568). Washington DC: U.S. Government Printing Office.

Wehmeyer, M. L. (2003). Self-determination, vocational rehabilitation, and workplace supports. *Journal of Vocational Rehabilitation, 19*, 67–69.

Wehmeyer, M. L., & Palmer, S. B. (2003). Adult outcomes for students with cognitive disabilities three-years after high school: The impact of self-determination. *Education and Training in Developmental Disabilities, 38*, 131-144.

Wehmeyer, M. L., & Schwartz, M. (1997). Self-determination and positive adult outcomes: A follow-up study of youth with mental retardation or learning disabilities. *Exceptional Children, 63*, 245-255.

Zhao, C. M., & Kuh, G. D. (2004). Adding value: learning communities and student engagement. *Research in Higher Education, 45*(2), 115-138.

About the Authors

Margaretha Vreeburg Izzo received her BA degree in psychology and special education from D'Youville College, her MA in vocational special education from George Washington University, and her PhD in special education from The Ohio State University. She is currently a professor in psychiatry at The Ohio State University and serves as associate director of the OSU Nisonger Center as well as program director of the Special Education and Transition Services division at the OSU Nisonger Center. Dr. Izzo has over 30 years experience in the field of special education research. Her primary research interests include transition, self-determination, and vocational rehabilitation for young adults with disabilities. She can be reached by email at Margo.Izzo@osumc.edu.

Alexa Murrray received a BA degree in psychology from The University of Mississippi, a MGS (master in gerontological studies) degree from Miami University of Ohio, and a MA in clinical mental health counseling from The Ohio State University. She is currently a program manager in the Special Education and Transition Services division at The Ohio State University Nisonger Center. She has over 10 years experience in special and general education research. She can be reached by email at Alexa.Murray@osumc.edu.

Bianca McArrell received her BA in psychology from The Ohio State University. Her experiences include working as a research coordinator for the Special Education and Transition Services division at The Ohio State University Nisonger Center, where she has also served as a program manager and ability advisor for the Ohio STEM Ability Alliance. She currently works as a program manager in research education at The Ohio State University College of Medicine. Her research interests include etiology and locus of control in relation to self-efficacy. She can be reached by email at Bianca.Mcarrell@osumc.edu.

Sarah Priest received her BA degree in psychology from The Ohio State University and her MA in teaching from Oregon State University. Her professional experiences include serving in the Young Adult Transition Corps, an AmeriCorps program assisting youth with disabilities with transition from school to adult life. She has also taught at the elementary school level. She is currently a program coordinator for the Ohio STEM Ability Alliance project at The Ohio State University Nisonger Center. She can be reached by email at Sarah.Priest@osumc.edu.

Authors' Note

This research was supported by National Science Foundation Grant GRT00012452 awarded to The Ohio State University Nisonger Center. This research was also supported by Ohio Rehabilitation Services Commission and Ohio Board of Regents Grant GRT00020848 awarded to The Ohio State University Nisonger Center. In addition, NSF Grant HRD-0929006 facilitated the publication of this article.