Promising Interventions for Promoting STEM Fields to Students Who Have Disabilities

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Abstract: This study compared two groups of transition program participants—those with reported strengths and career goals in science, technology, engineering, or mathematics (STEM) and those without—regarding their characteristics and perceptions of the social, academic, and career benefits of program interventions. Consistent with previous research on gender and STEM, more males than females reported strengths and goals in STEM. Results suggest that type of disability may play a role in the perception of STEM fields as career options, perhaps resulting in less interest in these fields on the part of students with mobility/orthopedic impairments. While the STEM group expressed more interest in technology-related activities, non-STEM participants consistently rated themselves higher in self-advocacy skills and perceived that program participation improved their social skills more than did STEM participants. Regarding motivation to attend college, academic interest and love of learning/challenges was cited more often by members of the STEM group, while job/career preparation was identified by more of the non-STEM students. As far as motivation for employment, financial security was selected by significantly more of the STEM-oriented participants and pursuit of independent living was chosen by more of the non-STEM participants. Results suggest that program interventions may help change college study and career plans of those who do not initially have STEM interests. Based on the responses of the two groups in this study, the authors make program recommendations for increasing the representation of people with disabilities in STEM fields.

Key Words: technology, transition, self-determination

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A bachelor's degree or higher is a prerequisite for many challenging careers, particularly those in science, technology, engineering, and mathematics (STEM). However, people with disabilities are significantly underrepresented in postsecondary programs despite a moderate increase in college enrollment rates over the past 10 years (Blackorby & Wagner, 1996; National Council on Disability and Social Security Administration, 2000; Wagner, Newman, Cameto, & Levine, 2005), and few students with disabilities successfully pursue studies in STEM (National Science Foundation, 2004; Office of Disability Employment Policy, 2001). Females face additional challenges to pursuing STEM careers (Burgstahler & Doyle, 2005; Chinn, 1999; National Science Foundation, 2002, 2004). These factors contribute to the low number of adults with disabilities qualified for today's high-tech jobs (Benz, Yavonoff, & Doren, 1997; Blackorby & Wagner, 1996; Butterworth & Pitt-Catsouphes, 1997; National Organization on Disability, 2004). The situation raises serious concerns as the job market for more routine work is increasingly shifting overseas (Cavanagh, 2006; U.S. Department of Labor, Bureau of Statistics, 2004). The demand for qualified professionals has been widely recognized, and many observers agree on the need to raise the quality of mathematics and science education in U.S. schools. Two goals have been proposed—to raise the overall math and science achievement for all students and to stimulate and support high performing students capable of pursuing college studies and careers in STEM subjects (Cavanagh, 2006). For students with disabilities, STEM training may be promoted with the same dual purposes.

Enhanced support for people with disabilities during transition periods from high school to college and employment has been recommended by researchers and practitioners (Kohler & Chapman, 1999; National Council on Disability and Social Security Administration, 2000). Programs for racial/ethnic minorities, women, and people with disabilities have identified promising practices for bringing students from underrepresented groups into STEM fields. These include (a) hands-on science experiences in precollege environments, (b) work-based learning and research experiences, (c) bridge programs between academic levels, and (d) mentoring (Burgstahler & Cronheim, 2001; Cohen & Light, 2000; Doren & Benz, 1998; Kaye, 2000; National Science Foundation, 2005; Stainback, Stainback, & Wilkinson, 1992). Comprehensive projects that integrate a variety of interventions have been found to be more successful in recruiting and retaining students with disabilities in STEM fields than isolated efforts (American Association for the Advancement of Science, 2001; Malcom & Matyas, 1991; National Science Foundation, 2005). It has also been found that programs that offer multiple components and continued involvement of participants are more effective than single-strategy activities in encouraging low income and minority students to attend college (Cunningham, Redmond, & Merisotis, 2003).

Little empirical research data related to transition programs is reported in the literature (Fisher, 2000; Kohler & Chapman, 1999; Kohler & Hood, 2000; Kohler & Troesken, 1999). The current study builds on previous work (Kim-Rupnow & Burgstahler, 2004) by further comparing two groups of transition program participants, those with reported strengths and career goals in STEM and those without, regarding their characteristics and perceptions of the social, academic, and career benefits of program interventions. The current researchers hoped to gain insights that could be shared with programs designed to increase the participation of people with disabilities in STEM. Researchers in both studies analyzed data provided by participants of an exemplary transition program hosted by the Disabilities, Opportunities, Internetworking, and Technology (DO-IT) Center at the University of Washington in Seattle. The DO-IT Scholars program (DO-IT, 2006) was selected to be explored in the current study because (a) it serves students with a wide range of disabilities, (b) it has well-defined components that lend themselves to comparative analysis, (c) it has characteristics of successful programs that include longevity, prestigious awards, sustained operations, attention in the press, and ongoing support from funding agencies, and (d) as a result of support from the National Science Foundation, it has a large group of participants interested in STEM fields (National Science Foundation, 2005; Kim-Rupnow & Burgstahler, 2004).

Development of interests and competencies for STEM begins in the early years (Jacobs & Eccles 1992; Simpkins, Davis-Kean, & Eccles, 2006). However, high school is a time when many students are formulating career plans. Most DO-IT Scholars are accepted into this competitive program at the end of their sophomore year. These college-bound students face significant challenges in pursuing postsecondary studies and careers as a result of disabilities that impact their vision, hearing, mobility, learning, attention skills, social interactions, and health. When DO-IT Scholars move from high school to college, most continue to participate in the program as mentors to younger Scholars. DO-IT activities are designed to help participants develop self-determination, social, academic, technology, and career skills. The program employs three primary interventions. Each offers activities in all fields of study and careers, but funding from the NSF has assured that opportunities to increase interests and skills in STEM are available throughout.

> Summer Study – Scholars participate in multiple residential programs at the University of Washington, where they are introduced to other young people with disabilities, are trained in computer and Internet use, socialize, and prepare for college, careers, and independent living.
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> Year-round computer and Internet activities – Computer and Internet skills continue to develop year-round in support of academic and career development and facilitate communication with mentors and peers in a mentoring community.
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> Work experiences – Internships and other work-based learning activities give students opportunities to explore their own interests, develop skills, practice disclosing their disabilities and seek accommodations, use technology at worksites, and learn to work with supervisors and coworkers.

Findings of previous research regarding DO-IT interventions are reported in earlier articles; results from focus groups and surveys are summarized below:

> Parents of DO-IT Scholars reported that DO-IT increased their children's interest in college, awareness of career options, self-esteem, and self-advocacy, social, academic, and career/employment skills (Burgstahler, 2002).
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> DO-IT Scholars reported that DO-IT participation helped them prepare for college and employment, develop Internet, self-advocacy, computer, social, and independent living skills, increase awareness of career options, and increase self-esteem and perseverance (Burgstahler, 2003; Kim-Rupnow & Burgstahler, 2004).
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> > They reported the greatest effects of the Summer Study to be the development of social skills, followed by academic and career skills; and the greatest effects of the year-round computer and Internet activities to be the development of career skills, also followed by academic and social skills (Burgstahler, 2003; Kim-Rupnow & Burgstahler, 2004).
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> > Scholars reported positive aspects of email, which included being able to stay close to friends and family; to get answers to specific questions; to meet people from around the world; to communicate quickly, easily, and inexpensively with many people at one time; and to communicate independently without disclosing

their disabilities (Burgstahler & Cronheim, 2001; Burgstahler & Doyle, 2005). They predicted that access to the Internet would contribute to their success in college and careers, and reported that peer and mentor relationships provided psychosocial, academic, and career support, and furthered their academic and career interests (Burgstahler, 2003; Burgstahler & Cronheim, 2001; Burgstahler & Doyle, 2005; Kim-Rupnow & Burgstahler, 2004). In particular, most reported that DO-IT mentors stimulated interests in STEM (Burgstahler & Cronheim, 2001; Burgstahler & Doyle, 2005).

Those who participated in work-based learning opportunities reported increased motivation to work toward a career, knowledge about careers and the workplace, job-related skills, ability to work with supervisors and coworkers, and skills in self-advocating for accommodations (Burgstahler, 2001; Burgstahler, Bellman, & Lopez, 2004).

DO-IT Mentors – Mentors reported a variety of topics they discussed with Scholars, including STEM, college issues, disability-related issues, careers, and computers, adaptive technology, and the Internet (Burgstahler & Cronheim, 2001).

Research Questions for Current Study

With funding from the NSF, further analysis of the data collected in the retrospective survey of DO-IT Scholars (Kim-Rupnow & Burgstahler, 2004) was undertaken to compare two groups of DO-IT participants, those with reported strengths and career goals in STEM and those without, regarding their characteristics and perceptions of the social, academic, and career benefits of DO-IT interventions. The following research questions were addressed in the new study:

1. How do participants who have STEM strengths and career goals (the STEM group) compare with those who do not (non-STEM group) with respect to gender, disability type, primary/major areas of postsecondary study, and motivations for going to college and gaining employment?

2. How do participants who have STEM strengths and career goals compare with those who do not regarding perceived changes in themselves in the areas of academic skills, social skills, levels of preparation for college and employment, levels of awareness of career options, and personal characteristics such as perseverance and self-esteem during their participation in the DO-IT program?

3. How do participants who have STEM strengths and career goals compare with those who do not regarding perceived value of program components and what they consider to be the greatest overall impact of DO-IT on their lives?

Method

Participants

A total of 173 Scholars participated in the DO-IT program from 1993 to 2000. This number does not include one Scholar who passed away after the first Summer Study and another who dropped out of the program. Of the 173 participants, DO-IT was able to locate and contact 155. These individuals were sent an email message asking them to complete a web-based survey or, alternatively, to request an email version of the survey, and to give permission to include their responses in the study. Nonrespondents were mailed a follow-up printed survey and a postage-paid return envelope. Seventy-five Scholars responded to the questionnaire (44 via web-based questionnaire, 3 via email, and 28 via postal mail), resulting in a 48% response rate. This final sample of 75 consisted of almost even numbers of male (52%) and female (48%) participants who were up to 26 years old (with 81% of age 18-23). For 42% of the participants, their primary disability was a mobility/orthopedic impairment; the rest of the sample was fairly evenly divided with respect to sight, hearing, learning, and other disabilities. Ninety-one percent of the participants had graduated from high school at the time the survey was conducted.

Design and Procedure

The survey questionnaire was designed to collect perceptions of the impact of specific DO-IT Scholar interventions on respondent lives. The questionnaire was divided into four sections: (a) demographic information, (b) technology-enhanced Summer Study programs, (c) year-round computer and Internet activities, and (d) changes in Scholars as a result of participation. In the Summer Study section, respondents were asked to rate the value of program components such as career and college preparation on a scale ranging from 1 (not valuable at all) to 5 (extremely valuable). In the year-round computer and Internet activities section, respondents were asked to rate the importance of activities such as online communication with peers and mentors on a scale from 1 (not valuable at all) to 5 (extremely valuable). They also rated the value of both the Summer Study and year-round computer and Internet activities in developing their social, career, and academic skills on a scale from 1 (not valuable at all) to 5 (extremely valuable). In the final section, respondents retrospectively assessed their level of specific skills (e.g., self-advocacy) at three different points in their lives–before participating in DO-IT, after the first Summer Study, and at the time of the survey. Statistical analyses consisted of descriptive statistics, including frequency, cross-tabulation, and means, as well as inferential statistics, including Pearson Chi square test, independent-samples T-test, and mixed two-way repeated measures ANOVA. Open-ended responses were analyzed to identify themes in the narratives.

Results

Two groups of respondents were identified by their responses to questions about their academic strengths, personal strengths/talents, and career goals. About half of the respondents (37) reported having strengths and future career goals in areas related to science, technology, engineering, or mathematics (STEM group). The other half (36) did not report strengths and career goals in STEM (non-STEM group). Two subjects were coded as missing because they did not provide information on any of the three variables. Following is a summary of the results by research question.

Research Question 1: How do participants who have STEM strengths and career goals (the STEM group) compare with those who do not (non-STEM group) with respect to gender, age, disability type, primary/major areas of postsecondary study, and motivations for going to college and gaining employment?

Differences By Demographics

Gender

As indicated in Table 1, the STEM group contains nearly twice as many males as females (65% vs. 35%), while the non-STEM contains more females. Pearson's Chi square test confirms that this disproportionality is unlikely due to a chance distribution of males and females into the two groups (χ^2 (1, N = 73) = 3.95, p < .05).

Primary Disability

Participants provided information on their primary disabilities in the demographic section of the survey, which were then coded into five categories: mobility/orthopedic (coded "mobility" in the current study), sight, hearing/speech, learning, and other. The "other" category included health impairments (kidney disease, Lyme disease), seizure disorders, Tourette's, traumatic brain injury, and other conditions whose functional impact was not clear and did not fit into the disability-related categories. Table 1 shows the distribution patterns for the STEM and non-STEM groups. Because of the low prevalence of types of disabilities other than mobility, these data were dichotomized (mobility disability vs. other disability) for analysis with Pearson's Chi square test. Significantly fewer participants in the STEM group have a mobility disability when compared to the non-STEM group (27% vs. 58%; χ^2 (1, N = 73) = 7.32, p < .01). Put another way, students with mobility impairments were much less likely to report STEM strengths and career goals. Of the 31 respondents with mobility impairments, only one-third reported (10) STEM strengths and career goals. In contrast, of the 42 individuals with other types of disabilities, almost two-thirds (27) reported STEM strengths and career goals.

Primary/Major Areas of Postsecondary Study

Sixty-seven respondents had graduated from high school. Of these, 60 transitioned to postsecondary training and provided information on their areas of postsecondary study. Responses were coded into three categories: STEM-related, liberal/general, and undecided/unclassified. Table 1 shows that a majority of the respondents chose to study in an area aligned with their strengths and career goals. Because of the low prevalence of unclassified students (3 in total), this category was omitted from analysis with Pearson's Chi square test. This analysis confirms that the two groups differed significantly in their choices of majors, with the participants in the STEM group being more likely to study in STEM-related areas than those in the non-STEM group (χ^2 (1, N = 57) = 21.51, p < .001). Interestingly, there was a higher percentage of students in the non-STEM group who majored in STEM fields (26%) as compared to the percentage of those in the STEM group who majored in non-STEM fields (13%). However, a binomial test shows that the differences in the rates of interest-major crossover were not statistically significant (p = .079, ns).

Motivation for College and Employment

Sixty-five respondents, including those who had not yet graduated from high school, responded to open-ended questions about primary motivations for attending postsecondary school, as well as motivations for selection of careers. Responses on motivations for going to college were coded into 5 categories: academic interest/love of learning and challenges, commitment to family and friends, getting a good job or career preparation, pursuit of success in life, and other motivations. Table 1 shows the response patterns for the STEM and non-STEM groups. Because of the low prevalence in the pursuit of success and other motivation categories, they were omitted from analysis with Pearson's Chi square test. This analysis shows that the differences in response patterns between the remaining groups were significant at the .05 level (χ^2 (2, N = 56) = 5.93, p = .051). Examination of Table 1 reveals that academic interest and desire to learn were important to more members of the STEM group than of the non-STEM group, while getting a good job was identified as a primary motivator for more of the non-STEM respondents.

Pursuit of independent living and financial security were the most frequently selected motivators for seeking employment in both groups (see Table 1). The low response categories – contribution to social changes, helping others, and other motivations – were omitted from the analysis because the expected frequency in those cells fell below 5. Pearson's Chi square analysis shows that the group differences in the response patterns were significant at the .05 level (χ^2 (1, N = 52) = 3.82, p = .051). Examination of Table 1 reveals that financial security was selected by significantly more of the STEM group and pursuit of independent living was selected by significantly more of the non-STEM group.

Differences in Skills

Research Question 2: How do participants who have STEM strengths and career goals compare with those who do not regarding perceived changes in themselves in the areas of academic skills, social skills, levels of preparation for college and employment, levels of awareness of career options, and personal characteristics such as perseverance and self-esteem during their participation in the DO-IT program?

DO-IT Scholars were asked to assess their academic skills, social skills, levels of preparation for college and employment, levels of awareness of career options, and personal characteristics such as perseverance and self-esteem at three points: prior to their involvement in DO-IT (Phase 1), immediately following their first DO-IT Summer Study (Phase 2), and at the time of the current survey (Phase 3). An earlier analysis of the survey data (Kim-Rupnow & Burgstahler, 2004) revealed that, overall, DO-IT Scholars considered themselves significantly improved in these areas.

This upward trend was further analyzed in the current study by comparing the STEM and non-STEM groups over time. A 2 x 3 analysis of variance (ANOVA) with repeated measures was conducted with the STEM group membership as the between-group factor and the three time points (phases) as the within-group factor. With this design, a significant group by time interaction would indicate a different pattern of change in the dependent variables over time for the two groups.

Social Skills

A significant group by phase interaction was observed in the area of social skills (F (2, 65) = 3.26, $p < .05$), indicating that the pattern of change in perceived social skills was different for the STEM and non-STEM groups over the three phases of DO-IT participation. Further analyses of the interaction effect revealed that the non-STEM group increased more dramatically than did the STEM group despite significant improvements perceived by participants in both groups during the course of the DO-IT program (see Figure 1). Specifically, the two groups did not differ in social skills at Phase 1 (before DO-IT) (F (1, 66) = 1.20, $p = .28$) and Phase 2 (after the first DO-IT Summer Study) (F (1, 66) = .31, $p = .58$). However, significant group differences were observed at Phase 3 (F (1, 66) = 4.41, $p < .05$), with the non-STEM group reporting a higher level of social skills than the STEM group. When examining the simple main effect of phase within the group variable, participants in each group perceived significant social skill improvements over time (F (2, 65) = 13.14, $p < .001$) for the STEM group and (F (2, 65) = 19.12, $p < .001$) for the non-STEM group. Pairwise comparison further identified significant changes between Phases 1 and 2, and Phases 2 and 3 for each group; the mean difference in both pairs of comparisons was statistically significant at the .05 level based on a Bonferroni adjustment.

Self-Advocacy Skills

A significant main effect of Phase was observed (F (2, 126) = 73.26, $p < .001$), indicating that participants of both the STEM and non-STEM groups considered their self-advocacy skills improved significantly over time. In addition, the main effect of STEM/non-STEM group membership was significant (F (1, 63) = 7.71, $p < .01$). This result indicates that the STEM and non-STEM groups differed in perceptions of their self-advocacy skills, with participants in the non-STEM group rating themselves significantly higher in self-advocacy skills than those in the STEM group throughout the phases (see Figure 1). No significant interaction between the group and the levels of phase was observed.

Internet Skills, Computer Skills, Preparation for College and Employment, Perceived Career Options, Perseverance, Self-Esteem, and Independence

According to self-ratings, Internet skills of the participants improved significantly over time for both the STEM and non-STEM groups, as indicated by the significant main effect of phase (F (2, 64) = 63.36, $p < .001$). Pairwise comparisons further indicated that participants in both groups perceived significant increases in Internet skills from Phase 1 to Phase 2 and from Phase 2 to Phase 3. However, neither the main effect of the group, nor the interaction between group and phase was statistically significant at the .05 level, indicating that the participants in both groups improved similarly over time in the area of Internet skills. Similar statistical analyses were conducted regarding computer skills, level of preparation for college, perceived career options, level of preparation for employment, perseverance, self-esteem, and independence. The main effect of phase was consistently significant, indicating that the participants in both groups perceived improvements throughout the course of DO-IT with respect to these areas. In all cases, neither the main effect of the group, nor the interaction between group and phase was statistically significant, indicating that the participants in both groups improved similarly over time in the tested areas.

Differences in Impact

Research Question 3: How do participants who have STEM strengths and career goals compare with those who do not regarding perceived value of program components and what they consider to be the greatest overall impact of DO-IT on their lives?

Summer Study

Participants were asked to rate the value of each of the following Summer Study activities using a 5-point Likert scale with “1” representing “not valuable at all” and “5” representing “extremely valuable”: (a) computer and Internet use, (b) face-to-face interaction and developing relationships, (c) college preparation, (d) career preparation, and (e) internship at Summer Study. All of the activities were rated highly, with scores ranging from 3.85 to 4.50 for the STEM and 3.71 to 4.20 for the non-STEM groups (See Table 2). Participant ratings of each of the program components were analyzed using independent-samples t test to determine whether the perceived values were different for the STEM and non-STEM groups. No group differences were found in the ratings of any of the activities, indicating that participants in the two groups rated similarly the value of the activities offered at the Summer Study. In addition to program components, participants rated, using the same rating scheme, the overall value of Summer Study in developing specific social, academic, and career/employment skills (See Table 2). Even though the STEM group gave slightly higher ratings than did the non-STEM group regarding the value of Summer Study in developing such skills, these differences did not reach statistical significance.

Year-Round Computer and Internet Activities

In addition to the Summer Study program, DO-IT participants were provided year-round computer and Internet activities that included (a) access to a home computer, (b) access to adaptive technology, (c) online communication with peers, (d) online communication with adult mentors, and (e) access to information and resources on the Internet. All of the activities were rated as valuable by both the STEM and non-STEM groups, with access to a home computer and access to information, and resources on the Internet receiving the highest ratings (See Table 2). Group differences emerged on two of five year-round computer and Internet activities. Specifically, participants in the STEM group valued access to adaptive technology and access to information and resources on the Internet more highly than did those in the non-STEM group ($t(50) = 2.22$, $p < .05$, and $t(68) = 2.10$, $p < .05$) respectively. Furthermore, STEM group members also reported the overall year-round computer and Internet activities to be more valuable than did their non-STEM counterparts in developing their social skills ($t(65) = 2.31$, $p < .05$) and career/employment skills ($t(67) = 2.68$, $p < .05$). However, the two groups did not differ on the perceived value of such activities in developing academic skills.

Results of the qualitative data analysis were consistent with the quantitative findings. When participants were given an opportunity in an open-ended format to identify the aspects of the DO-IT programs perceived to be most valuable for promoting their positive social, academic, and employment outcomes, they mentioned social interaction, access to computer and Internet, mentors, and preparation for college and careers, including resume writing, mock interview, and field trips. For example, one participant commented that, "Just interacting with everybody and learning about everybody's life and lifestyles" is valuable. Another said, "The simple idea of staying in the dorms and show[ing] that it could be done was the most integral part." Other comments included: "DO-IT has shown me that information is empowerment and that through the computer and social networking there is virtually free access to information for everyone." "I looked at my disability and my life in a different light. I noticed that others had it worse than me, but that doesn't stop them. I felt that help shaped [*sic*] my life more." "I still am in close contact with my beloved mentor after 8 years. I pursued sign language because of the program and was a part of many disability awareness programs in college due to DO-IT." No qualitatively different response patterns were associated with the STEM and non-STEM groups.

Greatest Overall Impact of DO-IT

Members of STEM and non-STEM groups expressed similar views regarding the impact of DO-IT activities. Individual psychosocial development and readiness for college and career pursuits were the two main areas that emerged from participant responses to the open-ended question, "What has been the greatest impact of DO-IT on your life?" with almost equal number of people in each group, 53% vs. 47% in the STEM and 48% vs. 52% in non-STEM groups, valuing DO-IT each way.

Discussion and Implications for Other Programs

The current study was undertaken to compare characteristics and perceptions of the social, academic, and career benefits of DO-IT interventions of two groups of DO-IT Scholars – those with reported strengths and career goals in STEM and those without. Although the characteristics of participants in the two groups were similar and they responded similarly to many program components, differences between the two groups have implications for other programs that serve to increase the participation of students with disabilities in STEM fields.

Characteristics of Non-STEM and STEM-Oriented Participants

The researchers found significant differences in demographic variables between the two groups of students, including those related to gender, disability type, primary areas of postsecondary studies, and primary motivations for going to college and seeking employment.

Gender

More male than female participants reported strengths and career goals in STEM fields. This finding is consistent with the literature on STEM interest in the overall population, suggesting that students with disabilities face issues of gender equity in STEM education and occupations similar to those faced by members of the general population (National Science

Foundation, 2002, 2004). Programs designed to increase the representation of students with disabilities in STEM fields should consider applying strategies proved successful in increasing the representation of girls and women in STEM fields, such as working to increase math, science, and computers ability self-concepts; providing career counseling that includes science, math, and computer course requirements for a variety of STEM-related careers; mentoring; and offering motivating, out-of-school, hands-on, math and science activities (Zarrett & Malanchuk, 2005; Skolnick, Langbort, & Day,1982; Simpkins, Davis-Kean, & Eccles, 2006).

Disability Type

Differential post-school outcomes across disability categories have been found in earlier studies. For example, the National Longitudinal Transition Study Two (NLTS2) reported that youth with emotional disturbances, multiple disabilities including deaf-blindness, and other health impairments remained among the least likely to have finished high school. However, youth with orthopedic impairments in 2003 reported the second highest school completion rate 86% (following a rate of 94% for youth with visual impairments) and the fourth highest participation rate (40%) in postsecondary education (Wagner, Newman, Cameto, & Levine, 2005).

Researchers in the current study found an interesting phenomenon—the non-STEM group had a higher percentage of members with mobility impairments than the STEM group. The authors went further to separate strengths and career goals, and found that the aforementioned disproportionality was more salient with respect to the career goals variable than the strength variable. In other words, students with mobility impairments in the current study were less likely to report STEM career aspirations than STEM strengths when compared to their peers without mobility impairments. Students develop academic and career interests as they grow up and a multitude of factors influence the process, including self-perceptions, parent and teacher expectations and beliefs, home environment, school experiences, participation in structured out-of-school activities, peer influences, and community experiences (Simpkins, Davis-Kean, and Eccles, 2006; Simpkins & Davis-Kean, 2005; Eccles, Midgley, & Adler, 1984; Jacob & Eccles, 1992). Disability type may play a role by directly and/or indirectly (through the mediating effects of the expectations of parents, teachers, and others) influencing a student's perception of STEM fields as viable career options. The authors suspect that parents, teachers, and students themselves, who are often unaware of the great variety of career options in STEM fields and of assistive technology that provides access to computers and scientific equipment, may perceive STEM fields as posing too many physical barriers to those with disabilities that affect mobility. Students with mobility impairments who have STEM interests might be discouraged from considering STEM fields as career options. Programs designed to increase participation in STEM should be aware of stereotypes and other negative attitudes concerning the appropriateness of STEM fields for people with certain types of disabilities. In school and transition programs, efforts should be made to increase the awareness of assistive technology and the wide variety of types of career positions in STEM fields among students with mobility impairments, their parents, educators, and service providers, so that these students will not steer away from STEM career paths simply because of their disabilities. Participants should be encouraged to look beyond the physical abilities typically used in a science lab (e.g., holding beakers) to careers that apply STEM knowledge in ways that do not require performance of these tasks (e.g., statistical analysis of lab results). As one Scholar articulated, what he gained from DO-IT participation was, "Realizing that I had more career choices than I previously thought I had."

Area of Postsecondary Study

A majority of the Scholars in each group chose postsecondary study in an area aligned with their reported strengths and career goals. It was reasonable to expect that students with STEM strengths/career goals would be more likely to major in STEM fields, and the statistical analysis supports this hypothesis. Interestingly, there was a higher percentage of Scholars in the non-STEM group who ended up majoring in STEM fields (26%) than of Scholars in the STEM group who majored in non-STEM fields (12%). Even though it is inconclusive as to whether DO-IT interventions encouraged participants to major in STEM, findings in this study suggest that career decisions are subject to influences and change as young adults engage in exploring various career options in search for the best fit. DO-IT provided these participants opportunities for exploration through hands-on science experiences, work-based learning, exposure to assistive technology, access to mentors and peers, and skill training. Findings suggest that programs designed to increase STEM participation for students with disabilities should not ignore students who are not initially interested in STEM. Instead, interventions should be tailored to the interests of these students and provide opportunities that may increase their awareness of the wide variety of STEM careers, interest in STEM, and confidence in pursuing STEM fields.

Motivation to Attend College

The two groups of participants differed in their primary motivations for attending college. Academic interest and love of learning/challenges was cited as important to more of the STEM-oriented students, while job/career preparation was identified as a primary motivator for more of the non-STEM students. These results are consistent with the findings from research on young adults' decisions to pursue math, science, and information technology careers. Zarrett & Malanchuk (2005) found that individuals with both high interest in computers and positive self-concepts in math and computers were most likely to aspire to information technology (IT) professions. The findings suggest that programs designed to increase participation in STEM should capitalize on the academic interests and strengths in STEM-oriented students, and at the same time, make sure that non-STEM-oriented participants learn about the many career opportunities available in STEM fields through work-based learning, Internet searches, and other activities.

Motivation to Seek Employment

Pursuit of independent living and financial security were reported as the top two motivations for seeking employment, but what is more interesting and worth noting is the group differences. While financial security was selected by significantly more of the STEM-oriented participants, pursuit of independent living was chosen by more of the non-STEM participants. The pattern of differences poses interesting questions as the link between the STEM and non-STEM groups and these motivators is likely to be mediated through other variables. Further examination of the characteristics associated with STEM and non-STEM participants, such as mobility impairments and gender, will be helpful to better understand the association between the STEM and non-STEM orientations and motivations for pursuing employment. These results also suggest that it is important that DO-IT and similar programs help students develop practical skills in independent living and employment that can bring financial security.

Perceived Value of Program Components

Technology

There were some differences regarding the perceived value of information technology between the STEM and non-STEM groups. The STEM group rated year-round computer and Internet activities, especially the access to adaptive technology and to information and resources on the Internet, higher than did their counterparts in the non-STEM group. Research findings suggest that program organizers be aware that technology use might be considered more valuable by participants with STEM strengths and goals than by those who do not report STEM strengths or goals. Efforts to tailor technology interventions to the specific interests of students with little interest in STEM should be undertaken. With mentors from STEM fields, the Internet can be used to support a community that promotes STEM interest within a social setting. In this case, participants with little interest in STEM studies and careers might be drawn more to working with people than to working with the technology alone. Technology could become more appealing to this group when it is used to address the needs of these students to be socially connected with others, perhaps through group work and interaction with peers and mentors.

Skill Building

Overall, DO-IT Scholars reported themselves improved in academic skills, social skills, levels of preparation for college and employment, levels of awareness of career options, and personal characteristics such as perseverance and self-esteem during the course of their participation in the DO-IT program. They learned from program activities and from each other. As reported by one participant with a hearing impairment, “I started using sign language after I saw that I understood it when watching the interpreters. Now I use interpreters for education, large meetings, conferences, classes, etc.” The impact of the program in developing participant skills and opening their eyes to new possibilities was a common theme among respondents, regardless of their STEM or non-STEM orientations: “I realized that I had more career choices than I thought I had.” “I am becoming more independent.” “I learned how to advocate for myself.” Group-related differences were not large with non-STEM-oriented participants consistently reporting higher levels of self-advocacy skills and social skills than STEM participants. The higher levels of social and self-advocacy skills perceived by the non-STEM group may be related to the reported strengths of these participants, which often included communication, people, and/or negotiation skills.

Participants, STEM-oriented or not, valued the skills, experiences, and encouragement they gained from Scholar involvement. The experiences and insights of survey participants can help other transition programs enhance the college and vocational success of students with disabilities. As previously reported by Kim-Rupnow and Burgstahler (2004), aspects of the program considered essential to helping participants achieve positive social, academic, and employment outcomes include access to computers and the Internet, development of social skills, self-advocacy skills, and self-esteem; and preparation for college and careers. The comprehensive combination of technology-enhanced learning activities, on-site, hands-on activities, and work-based learning experiences that DO-IT provides may have more impact on academic and career outcomes than either approach separately, as has been previously reported in the literature (American Association for the Advancement of Science, 2001; Cunningham, Redmond, & Merisotis, 2003; Malcom & Matyas, 1991; National Science Foundation, 2005). Other programs should also consider providing a comprehensive set of interventions that assure technology access to support the development of academic and career skills, peer and mentor interaction, and smooth transitions between academic and employment levels of involvement.

Limitations of the Study and Recommendations for Further Research

The findings of the current study apply to the population that DO-IT participants are drawn from—college-bound teens with disabilities who are motivated to participate in an extracurricular technology, academic, and career program with a reputation and program that encourages consideration of STEM fields and who have supportive adults to assist with the application process. Caution should be exercised in generalizing the results of this study to other populations. They should be interpreted in light of limitations reported in the earlier study (Kim-Rupnow & Burgstahler, 2004). Specifically, the response rate of the present study was 48%; a larger sample could have yielded more power to the analyses involving multiple subgroups. Also, the impact of program components was based on the retrospective self-reporting of survey respondents. Their perceptions may not accurately reflect the actual impact of specific interventions due to potentially skewed recalls and subjectivity of self-assessment. Self-rating, as well as quantitative measures at actual points in time, might have given more objective evaluations.

The results of this study suggest a number of important issues to address in further research. First, more longitudinal follow-up research on programs like DO-IT is needed, since little of such data is currently available in published literature. Collection of evaluation data should occur at critical steps – such as before the Summer Study, immediately after the Summer Study, six months later, one year later, and several years later – in order to detect the long-term effect of program activities. Second, empirical studies that include both program participants and non-participant peers should be conducted since comparisons made to a control group provide more convincing data regarding program effectiveness. Third, multiple methods and multiple perspectives should be incorporated; data from parents, high school teachers, counselors, and program staff provide additional perspectives regarding program effectiveness. Fourth, further examinations on relationships between program perceptions and impact, and gender and disability type, should be conducted to provide insight on how to tailor program activities to specific participants. For example, further studies are needed to understand the complex relationships between mobility impairments and the development of STEM-related academic interests and career choices, including the social and environmental factors that moderate such relations. Fifth, a follow-up study could be designed to help us understand what interventions made some participants in the current study turn away from other interests and goals to pursue STEM careers. Lastly, more empirical research is needed to determine the long-term impact of technology-oriented summer programs, online and on-site peer and mentor supports, and other college and career transition supports on increasing potential interest in and pursuit of STEM fields among students with disabilities.

Conclusion

This study was undertaken to explore differences in the characteristics of two groups of participants in a transition program—those with reported strengths and career goals in STEM and those without – and their perceived social, academic, and career outcomes as a result of participation. Consistent with previous research, more males than females reported initial strengths and goals in STEM. The smaller percentage of participants with mobility impairments reporting STEM orientation suggests that disability type may play a role in student perceptions of STEM fields as career options. Research results suggest that it may be possible for programs to increase the interests in STEM careers of individuals not initially oriented in these areas. This result is encouraging for DO-IT and similar programs that serve to increase participation in STEM careers by people with disabilities. Those without reported interests, aptitudes, or career goals in STEM tended to value social opportunities and development more highly than those with STEM interests and reported less interest in technology-related activities. Non-STEM participants consistently rated themselves higher in self-advocacy skills and perceived that program participation improved their social skills more than STEM participants.

Programs should keep in mind differences between participants with initial STEM strengths and goals, and those without, as they tailor activities to the needs of their participants. Such programs should take special steps to recruit: (a) females (because, as a group, they are less likely to have an interest in STEM already) and (b) students with mobility disabilities who show interest in STEM, yet have low expectations for pursuing STEM fields due to various reasons. For example, in the DO-IT Scholars program, students with all interests are recruited and a large number of program activities, but not all, are STEM-related. Programs that serve to increase the representation of people with disabilities in STEM fields should also undertake efforts to document their practices, institute pre and post-tests, and follow up with participants to assess both overall program outcomes and the relative value of specific interventions for specific groups of students. Dissemination of results can help others improve postsecondary academic and career outcomes for people with disabilities. One vehicle for dissemination is the series of promising practices published in the AccessSTEM Knowledge Base (DO-IT, n.d.).

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Table 1

Percentages (Numbers) of Responses Regarding Gender, Disability, Area of Postsecondary Study, and Primary Motivations for Postsecondary Education and Employment, by STEM & Non-STEM Groups

Category	STEM	Non-STEM
Gender		
Male	64.9% (24)	41.7% (15)
Female	35.1% (13)	58.3% (21)
Primary disability		
Mobility	27.0% (10)	58.3% (21)
Sight	19.0% (7)	8.3% (3)
Hearing/Speech	16.2% (6)	5.6% (2)
Learning	16.2% (6)	8.3% (3)
Other	21.6% (8)	19.4% (7)
Primary disability (dichotomized)		
Mobility	27.0% (10)	58.3% (21)
Non-mobility	73.0% (27)	41.7% (15)
Area of postsecondary study (unclassified omitted)		
STEM-related	86.7% (26)	25.9% (7)
Liberal/General	13.3% (4)	74.1% (20)
Primary motivation for postsecondary education		
Academic interest/Love of learning/Challenges	39.4% (13)	15.6% (5)
Commitment to family and friends	21.2% (7)	12.5% (4)
Getting a good job/Career preparation	30.3% (10)	53.1% (17)
Success in life	3.0% (1)	9.4% (3)
Other	6.1% (2)	9.4% (3)
Primary motivation for employment		
Pursuit of independent living	26.7% (8)	48.4% (15)
Financial security/Incentive plan	60.0% (18)	35.5% (11)
Contribution to social change	.0% (0)	3.2% (1)
Helping others	6.7% (2)	3.2% (1)
Other	6.7% (2)	9.7% (3)

Table 2

Rating Differences between STEM and Non-STEM Groups Regarding DO-IT Summer Study and Year-Round Computer and Internet Activities

DO-IT program activities	STEM		non-STEM		*df*	*t*
	M	*SD*	*M*	*SD*		
Summer Study activities						
Computer and Internet use	4.50	0.61	4.20	0.99	69	1.54
Face to face interaction and developing relationships	4.29	0.72	4.03	1.07	67	1.21
College preparation	4.14	0.87	3.94	1.08	69	0.84
Career preparation	3.85	0.86	3.71	1.03	66	0.64
Internship at Summer Study	4.06	1.00	4.11	0.99	35	-0.15
Summer Study activities in developing						
Social skills	4.00	0.70	3.71	0.91	66	1.50
Academic skills	3.66	0.91	3.32	1.04	67	1.43
Career skills	3.97	0.78	3.67	1.05	63	1.31
Year-round computer and Internet activities						
Access to home computer	4.55	0.91	4.56	0.71	56	-0.07
Access to adaptive technology	4.32	1.12	3.50	1.53	50	2.22*
Online communication with peers	3.94	1.04	3.58	1.20	67	1.37
Online communication with adult mentor	3.89	1.14	3.63	1.19	66	0.94
Access to information and resources on the Internet	4.57	.69	4.18	0.85	68	2.10*
Year-round computer and Internet activities in developing						
Social skills	3.79	0.91	3.21	1.14	65	2.31*
Academic skills	4.18	0.83	3.91	0.91	69	1.25
Career skills	4.25	0.72	3.65	1.05	67	2.68**

Note. * $p < .05$. ** $p < .01$