Students with Disabilities Choosing Science Technology Engineering and Math (STEM) Majors in Postsecondary Institutions

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Abstract

Many science, technology, engineering and math (STEM) studies have focused on issues related to underrepresented groups' participation in STEM disciplines. Most of these studies have targeted women and individuals from racial minorities as the underrepresented groups of interest, while little attention has been paid to people with disabilities. Extracting a nationally represented sample of students with disabilities from the National Longitudinal Transition Study-2, this study investigated whether and to what extent the selected demographic and academic factors predict STEM major choices by type of postsecondary institutions. Based on the literature on STEM students without disabilities, logistic regression analyses yielded both expected and unexpected results. As expected, female students with disabilities were substantially underrepresented in STEM majors in all types of postsecondary institutions. At 2-year or community colleges, White and Asian-American students with disabilities substantially dominated STEM majors over other racial groups. At 4-year postsecondary institutions, students with disabilities who enrolled in STEM majors showed higher high school GPA in math compared to non-STEM students with disabilities. Unexpectedly, at 4-year as well as vocational and technical postsecondary institutions, students with disabilities from lower-income backgrounds were significantly more likely to choose STEM majors compared to their counterparts. The results provide insights into career and academic resources that can help students with disabilities prepare for STEM careers.

Keywords: Disability, STEM majors, postsecondary institutions, and logistic regression

Many studies have investigated ways to encourage underrepresented groups to participate in the STEM workforce. Among the underrepresented groups, the majority of these studies targeted women and individuals from racial minority groups, while only a few studies considered people with disabilities. This gap in the literature may imply that many stakeholders, including scholars, doubt that people with disabilities can succeed in STEM education and related career. In fact, studies showed that students with disabilities are often discouraged from taking science and engineering courses at the K-12 level (Alston, Bell, & Hampton, 2002; Alston & Hampton, 2000; Alston, Hampton, Bell, & Strauss, 1998; National Science Foundation, 2002). Moreover, students with disabilities are not fully supported to participate in STEM-related courses due to teachers' lack of skills and knowledge related to inclusion (Bargerhuff, Cowan, & Kirch, 2010; Johnson, 2000; Mumba & Chitiyo, 2008; Rule, Stefanich, Haselhuhn, & Peiffer, 2009; Scadden, 2001; Todds, 2008).

Most STEM studies on people with disabilities have addressed how challenging it is for these individuals to pursue STEM education while only a few have investigated their participation in STEM fields. Among these, research conducted by Lee (2011) found that students with disabilities were significantly more likely to enroll in STEM majors compared to students without disabilities at 2-year or community colleges through comparing two nationally representative samples selected from the National Longitudinal Transition Study-2 (NLTS-2) and the Educational Longitudinal Study of 2002 (ELS: 2002). This promising outcome should be enough to encourage subsequent studies that focus on the pathways students with disabilities can take to pursue STEM careers. This study also extends Lee's work through proposing the following research questions.

Research Questions

1. To what extent do the selected student demographic characteristics and high school math GPA predict STEM major enrollment in 2-year or community colleges?

2. To what extent do the selected student demographic characteristics and high school math GPA predict STEM major enrollment in 4-year colleges and universities?

3. To what extent do the selected student demographic characteristics and high school math GPA predict STEM major enrollment in vocational and technical postsecondary schools?

Literature Review

Concerning the dire shortage of STEM workforce, the National Science Foundation's Committee on Equal Opportunities in Science and Engineering (CEOSE) was established for the purpose of encouraging underrepresented groups, including women, minorities, and people with disabilities, to participate in the STEM workforce (CEOSE, 2009). Aligned with the goal of the CEOSE, a considerable number of studies have investigated various issues regarding STEM education and careers of women and racial minority groups without considering disability status. However, a dearth of studies has targeted people with disabilities in STEM education and career in spite of the sizeable proportion of people with disabilities who pursue STEM interests. The U.S. Census Bureau indicated that approximately 13% of workers aged 21 to 64 years and about 18% of the U.S. population aged 5 years and older have some form of disability (as cited in National Science Foundation, 2006).

The few STEM studies that focused on people with disabilities did not explore STEM pathways of people with disabilities sufficiently, while several studies have examined the obstacles that students with disabilities often face in STEM classrooms at the K-12 and higher education levels. In response, this study aimed to investigate whether and to what extent certain demographic and academic factors predict students with disabilities' major selection, paying attention to different types of postsecondary institutions. The current study was developed based on the findings of Lee's study (2011). Lee compared STEM enrollment rates between students with and without disabilities, considering student demographic characteristics. The major findings from the comparison analyses showed that (a) students with disabilities who enrolled in 2-year colleges were substantially more likely to choose STEM majors compared to students without disabilities; (b) regardless of types of postsecondary institutions, both female students with and without disabilities were substantially underrepresented in STEM disciplines; and (c) in terms of racial/ethnicity backgrounds, African-American students with disabilities were less likely to choose STEM majors compared to their peers without disabilities.

To extend Lee's study, this research extracted students with disabilities who chose STEM majors in postsecondary settings and explored predictors that contributed to STEM major choices by different types of postsecondary institutions. This study considered gender, race, household-income levels, and high school GPA in mathematics. The types of postsecondary institutions were categorized as 2-year or community colleges, 4-year colleges or universities, and vocational and technical schools.

Conceptual Framework

This study was conceptually framed by the Learning Theory of Career Counseling ([LTCC]; Krumboltz, 1996). The LTCC indicated that genetic endowments and special abilities, environmental conditions, learning experiences, and task approach skills were four major components that influence an individual's career choice. Among the four major components, this study focused on genetic, environmental, and learning experience factors, which are assumed to be associated with career choices of students with disabilities. An individual's career choice in LTCC mirrored a student's college major choice in the current study, with the assumption that an individual's college major choice lays the foundation for pursuing a specific career.

For the generic components of LTCC, this study considered the gender and racial/ethnicity background of students with disabilities. Given the underrepresentation of women and racial minority groups in STEM fields, the effects of gender and racial/ethnicity were included along with other environmental and learning experience predictors affecting STEM major choices of students with disabilities. As an environmental factor, household income level was a major focus, assuming that the household economic condition of a student with a disability will influence the selection of a college major. The literature suggests that students from lower-income or socio-economic status (SES) backgrounds are underrepresented in STEM fields; however, most of these studies sampled students without disabilities (Ascher, 1985; Huang et al, 2000; Porter, 1990; Rot-

berg, 1990; Trusty, 2002; Wilson, 1990). High school GPA in mathematics was selected to assess the learning experience component of LTCC. According to LTCC, an individual has a tendency to pursue a career requiring the skills and knowledge that the individual is proficient in. Math performance is a well-known learning predictor of STEM major choices among individuals without disabilities; however, little is known about the effects of math performance on STEM major choices among individuals with disabilities.

In summary, among individuals without disabilities, the influence of genetic, environmental, and learning experience factors, as indicated by the LTCC, has been well documented on the decision to enter STEM disciplines. However, it has not been well understood whether and to what extent these factors predict students with disabilities' STEM major choices depending on types of postsecondary institutions.

Method

To analyze the proposed research questions, logistic regression was used because the study aimed to predict the dichotomous dependent variables (i.e., a student's STEM major choice in 2-year, 4-year, and vocational technical postsecondary institutions) associated with the selected independent variables (i.e., gender, race, students' income level, and high school math GPA). A national representative sample of youths with disabilities was extracted from the National Longitudinal Transition Study-2 (NLTS-2). The students in 2-year, 4-year, or vocational technical postsecondary institutions who were sampled in the study disclosed their college majors by 2005.

Data Source

The NLTS-2 was used to collect demographic characteristics, academic achievement, and college major choices from students with disabilities. The NLTS-2, sponsored by the Office of Special Education Program within the U.S. Department of Education, was designed to monitor longitudinally, from 2001 to 2009, academic progress and outcomes of students with disabilities attending secondary to postsecondary educations and/or working. The student participants in NLTS-2, who were 13 to 16 years of age as of December 1, 2000 and were in 7th grade or higher, were identified as people with disabilities within the federal 12 disability categories and received special education services. Note that the federal 12 disability categories are listed under disability types in Table 1. The NLTS-2 collected student information from multiple sources (i.e., interview and survey results from parents and students, direct assessment, and school data) over five waves extending from 2001 to 2009. This study used the wave 1, wave 3, and wave 5 data.

Based on the wave 1 dataset collected from 2001 to 2002, this study obtained student demographic characteristics information in terms of gender, race, and household income level. School staff gathered the information from the wave 1 data titled as "students' school survey program." Students' high school grade point average (GPA) in math was obtained from the wave 5 transcript dataset. The wave 3 dataset collected in 2005 contained students' major choices by types of postsecondary institutions. The wave 3 data titled as "wave 3 parents/youth survey" was collected based on the survey responses from youth and their parents. The selected variables are detailed in the next section.

Variables

Demographic characteristics and academic achievement in math were selected as the independent variables, which were assumed to predict the selection of STEM majors by students with disabilities. Regarding the demographic characteristics, this study accounted for gender, racial/ethnicity, and household income level. Considering student math achievement, the weighted average high school math GPA was used. The description of each variable follows.

Gender. The information about gender extracted from the wave 1 dataset was originally labeled as "w1_Gend2." Gender variable was initially coded for a categorical variable (i.e., 1 = male and 2 = female), but was re-coded to create a dummy variable (i.e., 0 =male, 1 = female).

Racial/Ethnicity Backgrounds. Racial/ethnic backgrounds of students with disabilities were obtained from wave 1 dataset. This variable was originally labeled as "w1_Eth6." Six racial/ethnicity categories were reported (i.e., 1 = White, 2 = African American/Black, 3 = Hispanic, 4 = Asian/Pacific Islander, 5 = American Indian/Alaska Native, and 6 = Multi/Other race). This variable was re-coded to create a dummy variable for racial majority group in STEM fields (i.e., 0 = racial minority group in STEM fields, 1 = racial majority group in STEM fields). The racial minority groups in STEM fields represented African-American/Black, Hispanic, American Indian/Alaska Native, and Multi/other races. White and Asian/Pacific Islander were characterized as the racial majority groups in STEM fields. The logistic regression indicated an effect of racial majority group in STEM fields. Note that the criteria of STEM racial minority and majority groups was determined according to the literature, which suggested that White and Asian-American students

were overrepresented in STEM fields while African-American, Hispanic, and American-Indian students were traditionally underrepresented (National Science Board, 2010).

Household Income Level. The information on the household income level was collected from the wave 1 dataset. This variable, which was originally labeled as "w1_Incm3," assessed three household income levels as follows: 1 = $25,000 and under; 2 = $25,001 to $50,000; and 3 = over $50,000. This variable was treated as a numerical variable in the logistic regression analysis.

High School GPA in Math. High school GPA in math represented students' math achievement in this study and was obtained from the wave 5 transcript data. This variable, originally labeled as "ntgGPA_Alt-Math." was defined as the weighted grade point average of the high school student participants in mathematics who attended either general or special education settings. The NLTS-2 described that the weighted grade point average was calculated as sum of weighted grade points ÷ sum of hours, noting that the weighted grade point = grade point*number of semester hours for math. The weighted grade point was scaled from 0 = low/F to 4 = high/A. This variable was treated as a numerical variable in the logistic regression analysis.

STEM Major Choice. A student's STEM major choice by type of postsecondary institution was the dichotomous dependent variable in this study. This variable was developed based on the parents' and youths' survey responses to the following questions: (a) What is your (or your child's) major or course of study at a 2-year/community college? (b) What is your (or your child's) major or course of study at a 4-year college or university? and (c) What is your (or your child's) course of study or training at a postsecondary vocational and technical school? In this study, the criteria for STEM majors were determined based on the STEM major categorization indicated in the Chen and Weko's report (2009) from the U.S. Department of Education. The STEM majors specified by Chen and Weko include mathematics, agricultural and natural sciences, physical sciences, biological sciences, engineering and engineering technologies, and computer and information sciences. These were matched to the following STEM categories in the NLTS-2: (a) mathematics and statistics in the category of mathematics; (b) agriculture related, science, biology, earth sciences, geology, physics, chemistry, and environmental science in the categories of agricultural and natural sciences; (c) engineering, electrical, mechanical, and chemical types of majors in the category of engineering and engineering technology; and (d) computer science, programming, information technologies, computer support, and web page development in the category of computer and information sciences. Based on this STEM classification, this variable was created as a dummy variable by being re-coded as 1 = STEM majors and 0 = non-STEM major.

Sample

This study included students who enrolled in postsecondary institutions who disclosed their majors by 2005. In terms of the types of postsecondary institutions, this study considered 2-year or community colleges, 4-year colleges or universities, and postsecondary vocational and technical schools. Data from 224 students at the 2-year or community colleges were extracted. Of the 224 students, 95 (42.41%) students selected STEM majors while 129 (57.59%) students selected non-STEM majors. Furthermore, the study included data from 347 students in 4-year colleges or universities. Out of the 347 students, 90 (25.94%) declared STEM and 257 (74.06%) non-STEM majors. Additionally, 324 students were selected from postsecondary vocational and technical schools, representing 138 STEM (42.59%) and 186 non-STEM students (57.41%). Table 1 shows the descriptive statistics of the STEM and non-STEM major enrollment by gender, racial/ethnicity, household income levels, and disability types in each type of postsecondary institutions.

Results

Descriptive statistics of the selected independent variables by types of postsecondary institutions are presented first, followed by the logistic regression analyses. Table 2 shows the descriptive statistics of the selected variables by types of postsecondary institutions.

As shown in Table 2, at 2-year or community colleges, the mean of .08 for gender in STEM majors indicated that 8% of all STEM students were female students. Likewise, at 4-year colleges or universities, female students represented 17% of STEM students. At postsecondary vocational technical schools, female students comprised 12% of all STEM students. Regarding racial/ethnicity backgrounds, 81% of the STEM students at 2-year or community colleges were White and Asian-American. At 4-year colleges or universities, White and Asian-American students comprised 80% of all STEM students. At postsecondary vocational and technical schools, 71% of STEM students were White and Asian-American. Regarding the household income levels, the average income of STEM students at 2 year or community colleges was 2.26, which was slightly lower than 2.29 reported for non-STEM students. At

Table 1

Percentage of Students who Enrolled in STEM and Non-STEM Major by Student Demographic Characteristics

Demographic Characteristics	Postsecondary Institution Types					
	2-year or Community Colleges		4-Year Colleges or Universities		Vocational and Technical Schools	
	STEM	non-STEM	STEM	non-STEM	STEM	non-STEM
Gender						
Male	91.58% (87)	57.36% (74)	83.33% (75)	52.92%(136)	87.77%(122)	49.46%(92)
Female	8.42%(8)	42.64%(55)	16.67%(15)	47.08%(121)	12.23%(17)	50.54%(94)
Total	100%(95)	100%(129)	100%(90)	100%(257)	100%(139)	100%(186)
Race/Ethnicity						
White	78.95%(75)	67.44%(87)	78.89%(71)	74.81%(193)	69.57%(96)	64.52%(120)
African-American	7.37%(7)	16.28%(21)	8.89%(8)	13.57%(35)	20.29%(28)	16.13%(30)
Hispanic	10.53%(10)	13.18%(17)	10.00%(9)	9.30%(24)	5.80%(8)	17.20%(32)
Asian-American	2.11%(2)	2.33%(3)	1.11%(1)	1.94%(5)	1.45%(2)	2.15%(4)
American-Indian	1.05%(1)	0.00%(0)	1.11%(1)	0.00%(0)	2.17%(3)	0.00%(0)
Other/Multi races	0.00%(0)	0.78%(1)	0.00%(0)	0.39%(1)	0.72%(1)	0.00%(0)
Total	100%(95)	100%(129)	100%(90)	100%(258)	100%(138)	100%(186)
Income Level						
$25,000 and Under	18.95%(18)	17.83%(23)	14.44%(13)	12.02%(31)	23.02%(32)	20.43%(38)
$25,001 to $50,000	35.79%(34)	34.88%(45)	36.67%(33)	28.29%(73)	44.60%(62)	36.56%(68)
Over $50,000	45.26%(43)	47.29%(61)	48.89%(44)	59.69%(154)	32.37%(45)	43.01%(80)
Total	100%(95)	100%(129)	100%(90)	100%(258)	100%(139)	100%(186)
Disability Type						
Learning Disability	11.58%(11)	13.95%(18)	8.89%(8)	7.36%(19)	5.76%(8)	11.29%(21)
Speech Impairment	6.3%(6)	9.30%(12)	16.67%(15)	11.63%(30)	12.23%(17)	9.14%(17)
Mental Retardation	1.05%(1)	3.88%(5)	0.00%(0)	1.16%(3)	6.47%(9)	5.91%(11)
Emotional Disturbance	7.37%(7)	7.75%(10)	1.11%(1)	5.04%(13)	14.39%(20)	6.45%(12)
Hearing Impairment	10.53%(10)	10.08%(13)	20.00%(18)	18.60%(48)	13.67%(19)	12.90%(24)
Visual Impairment	7.37%(7)	10.85%(14)	15.56%(14)	19.77%(51)	8.63%(12)	7.53%(14)
Orthopedic Impairment	8.42%(8)	12.40%(16)	12.22%(11)	14.34%(37)	7.91%(11)	13.44%(25)
Health Impairment	23.16%(22)	17.05%(22)	11.11%(10)	12.02%(31)	15.83%(22)	12.90%(24)
Autism	6.32%(6)	6.98% (9)	6.67% (6)	4.65%(12)	6.47%(9)	5.38%(10)
Traumatic Brain Injury	10.53%(10)	1.55%(2)	4.44%(4)	2.71%(7)	5.04%(7)	3.76%(7)
Multiple disabilities	6.32%(6)	4.65%(6)	1.11%(1)	1.94%(5)	3.60%(5)	6.99%(13)
Deaf/Blindness	1.05%(1)	1.55%(2)	2.22%(2)	0.78%(2)	0.00%(0)	4.30%(8)
Total	100%(95)	100%(129)	100%(90)	100%(258)	100%(139)	100%(186)

Note. Number of students in parentheses.

Table 2

Summary Information of the Gender, Race, Household Income Level, and High School Math GPA Model Variables Among Students with Disabilities

	Type of Postsecondary Institution					
	2-Year or Community Colleges		4-Year Colleges or Universities		Vocational and Technical Schools	
	STEM	non-STEM	STEM	non-STEM	STEM	non-STEM
Variables						
% of Female	8%	43%	17%	47%	12%	51%
% of Racial Majority	81%	70%	80%	77%	71%	67%
	Mean (Standard Deviation)					
Income Level	2.26(.76)	2.29(.75)	2.34(.72)	2.48(.70)	2.09(.74)	2.23(.77)
Math GPA	2.33(1.08)	2.43(.89)	2.78(.88)	2.63(.83)	2.26(.92)	2.35(.92)
Sample	95	129	90	257	138	186

Note. Standard deviation in parentheses.

the 4-year colleges or universities, STEM students' average household income was 2.34, which was lower than 2.48 reported for non-STEM students' average household income. At the postsecondary vocational and technical schools, the average household income for STEM students was 2.09, which was lower than 2.23 reported for non-STEM students. In terms of math GPA at the high school level, at 2-year or community colleges, STEM students had the average math GPA of 2.33, which was lower than 2.43 reported for non-STEM students' math GPA. At 4-year colleges or universities, the average math GPA of STEM students was 2.78, which was higher than 2.63 reported for non-STEM students. At the vocational and technical schools, STEM students' average math GPA was 2.26, which was lower than 2.35 reported for non-STEM students' average math GPA.

In summary, female students with disabilities were substantially less likely than their male counterparts to enroll in STEM majors, regardless of the types of postsecondary institutions, similar to female students without disabilities' underrepresentation in STEM fields. Unsurprisingly, White and Asian-American students with disabilities dominated STEM fields, regardless of the types of postsecondary institutions. This pattern was also similar to that of students without disabilities. However, interestingly, among students with disabilities, students from lower-income backgrounds seemed to choose STEM majors more than did their peers from higher-income backgrounds. Moreover, in terms of math GPA, STEM students enrolled in 4-year postsecondary institutions achieved a higher math GPA on average compared to non-STEM students while the average math GPAs at the other postsecondary institutions were lower for STEM students compared to non-STEM students. In the next step, employing logistic regression analyses, this study investigated whether and to what extent the selected independent variables predicted significantly STEM major choices.

Research Question 1. To what extent do the selected student demographic characteristics and high school math GPA predict STEM major enrollment in 2-year or community colleges?

As shown in Table 3, female students with disabilities at 2-year or community colleges were significantly less likely to choose STEM majors compared to male students with disabilities ($p <$. 01). The odds ratio of .11 suggested that female students with disabilities were 89% [100 x (odds ratio -1) = -89] less likely to choose STEM majors compared to male students with disabilities. Regarding racial/ethnicity backgrounds, White and Asian-American students with disabilities were more likely to enter STEM disciplines compared to other racial groups with disabilities ($p <$.05). The odds ratio of 2.41 for race suggests that White and Asian-American students with disabilities were 2.41 times more likely to choose STEM majors compared to other racial minority peers. These results were consistent with results from several previous studies conducted with students without disabilities. However,

household income level and high school math GPA did not significantly impact the likelihood of choosing a STEM major. In terms of logistic regression, the Hosmer-Lemeshow (H-L) goodness-of-fit test yielded an $X^2(8)$ of 11.08 with an insignificant p-value ($p > .05$), suggesting that observed and expected values were not significantly different; thus, the model fit the data well.

Research Question 2. To what extent do the selected student demographic characteristics and high school math GPA predict STEM major enrollment in 4-year colleges and universities?

At 4-year colleges or universities, female students with disabilities were significantly underrepresented in STEM disciplines compared to male students with disabilities ($p < .01$) (see Table 3). The odds ratio of .21 for gender indicated that the likelihood of female students with disabilities choosing STEM majors was 79% lower compared to their male counterparts [100 x (odds ratio -1) = -79%]. Regarding the household income levels, students with disabilities from lower-income backgrounds were significantly more likely to choose STEM majors compared to students with disabilities from higher-income backgrounds ($p < .05$). Explicitly, the odds ratio of .64 suggested that for every one-unit decrease in income level, students with disabilities who came from lower-income backgrounds ($25,000 and under) were 1/0.64 = 1.56 times more likely to select STEM majors compared to students with disabilities who came from higher-income backgrounds (between 25,001 and $50,000).

Regarding math GPA, students with disabilities who received higher math GPA were significantly more likely to enroll in STEM majors compared to their counterparts, although the significant level was marginal ($p < .10$). The odds ratio of 1.31 for math GPA suggested that students with disabilities were 1.31 times more likely to select STEM majors for every one-grade increase in math GPA. For example, those who gained the grade level of 4 in math GPA were 1.31 times more likely to enroll in STEM majors compared to those who earned the grade level of 3 in math GPA.

The effects of both gender and math GPA on STEM major choices did not differ for students without disabilities. However, an interesting finding was that lower household income levels were associated with higher likelihood of selecting STEM majors among students with disabilities at 4-year colleges or universities. This result is not consistent with previous findings on STEM students without disabilities. As noted earlier, among students without disabilities, students from lower-income or SES background were less likely to pursue STEM majors in college. Unlike the case of 2-year or community college, race was not a critical predictor of a student's STEM major selection. Note that the H-L test showed the model fit the data well, producing $X^2(8)$ of 5.22 with an insignificant p-value ($p > .05$).

Research Question 3. To what extent do the selected student demographic characteristics and high school math GPA predict STEM major enrollment in vocational and technical postsecondary schools?

At the postsecondary vocational and technical schools, similar to the 2-year and 4-year postsecondary institutions, female students with disabilities were substantially less likely to enroll in STEM majors compared to their male counterparts ($p <.01$). The odds ratio of .14 for gender explained that the likelihood of majoring STEM disciplines was 86% lower for female students with disabilities compared to male students with disabilities [100 x (odds ratio -1) = -86%]. The relationship between household income levels and STEM major choices was similar for 4-year colleges and universities. Students with disabilities from lower-income backgrounds were significantly more likely to enroll in STEM majors compared to their counterparts ($p <. 05$). Regarding the odds ratio of .70, for every one-unit decrease in income level, students with disabilities from lower-income backgrounds ($25,000 and under) were 1/0.70 = 1.43 times more likely to select STEM majors compared to students with disabilities who came from higher-income backgrounds (between $25,001 and $50,000). Namely, students with disabilities from lower-income backgrounds had a higher tendency to choose STEM majors. However, in vocational and technical postsecondary schools, race and high school math GPA were not significantly associated with the likelihood of choosing a STEM major. Note that the H-L test indicated that the logistic model fit the data well, $X^2(8)$ of 8.92, $p >.05$.

Discussion

Targeting students with disabilities, this study articulated the extent to which selected demographic and academic factors predict STEM major choices by types of postsecondary institutions. Based on the literature about the characteristics of STEM students without disabilities, some of the results were not surprising. Other results showed different patterns compared to those reported in previous findings. Female students' underrepresentation in STEM majors and overrepresentation of White and Asian students were the common phenomenon, regardless of disability status. For students with disabilities, math performance was a

marginally significant predictor of the enrollment in STEM majors in 4-year colleges or universities ($p < .10$). This finding is similar to the one found for the students without disabilities in STEM fields. However, the significant role of math performance did not emerge in 2-year and vocational technical postsecondary institutions. Interestingly, the household income level rather than math performance appeared to play a more critical role in students with disabilities' decision to prepare for STEM careers in 4-year colleges or universities and vocational technical postsecondary institutions. Unlike the students without disabilities, students with disabilities from the lower household income were more likely to select STEM majors. This result can have several interpretations.

It is much more challenging for people with disabilities to obtain employment compared to people without disabilities. The U.S. Bureau of Labor Statistics (2013) indicated that, between 2008 and 2013, the average employment rate of people with disabilities over the age of 16 is 18.28%, while that of people without disabilities is 63.82%. Such a substantial gap in the employment rates between people with and without disabilities seems to increase the awareness of people with disabilities about the realities of being hired. Thus, it might be reasonable to expect that with the much tougher job market for people with disabilities compared to people without disabilities, those from lower-income household backgrounds would be more motivated to find ways that would allow them to gain access to more job opportunities compared to their peers from higher-income households. People with disabilities who tend to struggle with household economic conditions seem to be more interested in STEM fields, which provide many secure and high-paying jobs. By gaining STEM skills and knowledge in postsecondary institutions, people with disabilities from lower-income backgrounds seemed to make greater efforts on increasing employment opportunities compared to their peers from higher-income backgrounds.

Along with the promising results from the previous study (Lee, 2011), the finding that low-income students with disabilities are more likely to select STEM majors suggests that many people with disabilities, particularly those who are economically disadvantaged, attempt to participate in STEM workforce occupations in spite of the challenges often faced in their learning process. While dismissing the belief or bias that people with disabilities could not be successful in STEM fields, diverse stakeholders, including educators and policy makers, should make concerted efforts to improve the learning environments tied to the needs of students with disabilities at both K-12 and higher education levels. As previously addressed, at the K-12 level, students with disabilities often face obstacles to participating fully in STEM-related classes primarily due to inappropriate or insufficient academic accommodation. Without a doubt, students in under-resourced and low-income communities face greater challenges associated with the engagement in STEM-related classes compared to their peers living in higher-income communities. Regarding this critical issue, professional development for STEM teachers should be promoted to help students with disabilities explore their potential and interest in STEM fields and provide them with equal educational opportunities to learn STEM regardless of disability status and household income levels.

At the higher education level, greater attention, beyond STEM enrollment, should be paid to providing support to college students with disabilities, increasing their chances to successfully graduate with STEM degrees and participate in the STEM workforce. Lee's study (2011) showed that STEM students with disabilities were significantly less likely to receive academic accommodation compared to non-STEM students with disabilities. The rationale supporting this finding remains unknown, but STEM students with disabilities seem to be in a more challenging educational environment, particularly in terms of obtaining academic accommodations, compared to their counterparts. In fact, based on the survey responses of 245 faculty members at a south central land grant university, a study showed that STEM faculty members were less willing to provide academic accommodations to students with disabilities compared to non-STEM faculty members (Rao & Gartin, 2003).

Regarding the lower frequency in STEM students with disabilities receiving academic accommodations compared to non-STEM students with disabilities, future studies need to investigate practical concerns relevant to learning environments of STEM college students with disabilities, with particular focus on the availability of academic accommodations. The studies should identify appropriate academic accommodation that would enhance students' learning outcomes, including retention and graduation in postsecondary institutions. It has often been reported that many students with disabilities who enroll in STEM courses face barriers to full participation in rigorous hands-on learning activities such as labs, and such barriers provide fewer opportunities to explore their career potential and interest in STEM disciplines compared to their counterparts (Moon, Todds, Morton, & Ivey, 2012). At the same time, students with disabilities are generally discouraged to pursue STEM degrees in postsecondary institutions (Moon et al., 2012).

Table 3

Logistic Regression Analyses Results by Type of Postsecondary Institutions

Variable	Type of Postsecondary Institutions														
	2-Year or Community Colleges					4-Year Colleges or Universities					Vocational & Technical Schools				
	B	S.E.	Wald	Sig.	Odds Ratio	B	S.E.	Wald	Sig.	Odds Ratio	B	S.E.	Wald	Sig.	Odds Ratio
Gender[1]	-2.19***	.42	27.45	.00	.11	-1.56***	.31	24.54	.00	.21	-1.99***	.30	43.99	.00	.14
Race[2]	.88**	.36	5.83	.01	2.41	.34	.36	.87	.35	1.40	.43	.29	2.22	.14	1.54
Income Level	-.26	.21	1.50	.22	.77	-.45**	.20	5.16	.02	.64	-.35**	.18	3.93	.04	.70
Math GPA	-.12	.15	.65	.42	.88	.27*	.16	2.86	.09	1.31	-.05	.13	.13	.72	.95
Model Fit															
H-L Test[3]			Chi-Square	*df*	*p*-value			Chi-Square	*df*	*p*-value			Chi-Square	*df*	*p*-value
			11.08	8	.197			5.22	8	.73			8.92	8	.35

Note. *** $p < .01$; ** $p < .05$;* $p < .10$

1. Recall that Gender was coded as female =1 and male = 0. Thus, the coefficient B of this variable indicates the female effect in the logistic regression model.

2. As indicated in the method section, Race was coded as racial majority groups in STEM fields = 1 and racial minority groups in STEM fields =0, noting that racial majority groups in STEM fields are White and Asian-American and racial minority groups in STEM fields are African-American, Hispanic, American-Indian, and Multi/other races. The coefficient B of this variable shows the effect of racial majority groups in STEM fields.

3. Hosmer - Lemeshow Test

Concerning the challenges of students with disabilities in pursuing STEM degrees, a recent study explored effective accommodations for improving STEM learning outcomes provided by eight STEM faculty participants who worked with students with disabilities (Moon, Utschig, Tood, & Bozzorg, 2011). The eight STEM faculty participants reported that most of their students provided positive feedback on group-based learning, which can help them learn how to collaborate with their classmates as well as understand the class materials effectively. Other academic accommodations included online-based learning materials (e.g., animations, interactive tutorials, and video clips), open-book, and pre-lecture quizzes. However, such preliminary findings with only eight faculty participants suggest the need to conduct more research on the accommodation for STEM students with disabilities with the consideration of multiple variables, including types of disability and courses.

Regardless of academic disciplines, faculty members at the postsecondary level often lack knowledge and experience to accommodate students with disabilities through instructional choices that can be framed by the principle of universal design of learning (UDL), which places an emphasis on inclusive teaching (Moon et al., 2012). Of note, Moon and colleagues added that UDL concepts are less likely to be applied to pedagogies for students with disabilities at the postsecondary level than at the K-12 level. Concerning the lack of awareness and implementation of UDL concepts in postsecondary institutions, additional research needs to identify the needs of students with disabilities that are required for successful graduation and workforce participation in all academic fields, including STEM disciplines. Such research based on postsecondary and career pathways of students with disabilities into either STEM or non-STEM will provide the guidelines for the effective career development aligned with individual differences.

Consistent with individual differences among students with disabilities, a future study should also analyze whether different effects of selected factors on STEM major choices exist by demographic characteristics, such as race/ethnicity backgrounds. This study did not elaborate on the effects of the selected variables on STEM major choices by different demographic characteristics due to insufficient data on specific demographic characteristics. However, it would be informative to study whether there are differences in the effects of selected variables on STEM major choices depending on student demographic characteristics.

In conclusion, the results imply that designing pedagogies and providing career advices tailored to individual differences would play a critical role in helping students with disabilities identify their potential in STEM fields and take STEM career pathway. Diverse stakeholders, including faculty members, should make every effort to provide academic resources that meet the interests and needs of students with disabilities, considering a wide range of individual differences, including types of disability, income level, and gender. Teaching and career advices that would consider individual differences would be a key to successful graduation and participation of individuals with disabilities in STEM disciplines.

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