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An Exploratory Investigation of the Postsecondary STEM Opportunities for People with Intellectual and Developmental Disabilities in the United States

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Corresponding Author:	Christina Carnahan, EdD UC: University of Cincinnati Cincinnati, Ohio UNITED STATES
First Author:	Christina Carnahan, EdD
Order of Authors:	Christina Carnahan, EdD
	Savannah Stark
	Dian Weinbrandt
	Katie Norland
	Emma DenBleyker
Manuscript Region of Origin:	UNITED STATES
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An Exploratory Investigation of the Postsecondary STEM Opportunities for People with Intellectual and Developmental Disabilities in the United States

Abstract

This study investigates the alignment of Postsecondary Education (PSE) programs with Science, Technology, Engineering, and Math (STEM) career demands for individuals with intellectual and developmental disabilities (IDD) in the US. Using a mixed methods design to explore what programs are offering STEM opportunities, a national survey was conducted with 56 PSE representatives, revealing 14 programs offering STEM experiences. Follow-up interviews provided insights into STEM pathways in these identified programs, emphasizing access to STEM for students with IDD, instruction on STEM skills and knowledge, support provided in STEM pathways, and the role of bias as a barrier to inclusion. The findings offer directions for future research on integrating STEM instruction and technical training in PSE programs for students with IDD while addressing barriers and supporting individuals with IDD.

Keywords: STEM education, program implementation, national survey, career preparation, STEM careers

Postsecondary STEM opportunities for people with intellectual and developmental disabilities in the United States

Historically, employment opportunities for individuals with intellectual and developmental disabilities (IDD) have been predominated by low skill positions in fields such as office support, retail, and food service (Hiersteiner et al., 2018). However, today's labor market is shifting; positions that have traditionally been available to individuals without specific technical skills are being increasingly automated (McKinsley & Co., 2022). By 2025, 65% of the workforce will need to obtain specific skills through industry recognized credentials, apprenticeships, or degrees (Team NEO, 2021). More than 3 million open positions for technical workers in Science, Technology, Engineering, and Math (STEM) fields are currently projected (National Science Board, 2020), many of which do not require four-year degrees. These jobs tend to pay well, with some estimates suggesting that as the market shifts, individuals working in STEM fields will earn 26% higher salaries compared to others (Mullin & Klimaitis, 2021).

The traditional pathways into these STEM fields are through four-year degrees, but there are increasing opportunities for individuals who obtain skills gained through less traditional paths such as industry-recognized credentials and apprenticeships (NSB, 2020). However, the increasing availability of alternate pathways has not resulted in sufficient numbers of well-trained workers who are prepared for and able to contribute to the evolving labor market demands. As such, identifying additional sources of qualified employees is essential to sustain innovation in an era of high-paced advances in technology. These untapped employee sources are referred to as the "missing millions" and include individuals from underrepresented groups such as people of color, women, and individuals with disabilities (NSB, 2020).

One group noticeably underrepresented in STEM are individuals with disabilities. Though people with disabilities are mentioned in diversification efforts, the percentage of individuals with disabilities working in STEM fields is low, with recent reports suggesting only 3% of STEM employees have a disability (National Center for Science and Engineering Statistics [NCSES], 2023). Recently, Shifrer and MacKin Freeman (2021) suggested that individuals with IDD are further marginalized, but their inclusion has the potential to impact how universally designed training can transform education for diverse groups and provide new, creative strategies for addressing STEM labor market needs. Barriers to STEM inclusion begin in k-12 education and persist through postsecondary and employment (Shifrer & Mackin Freeman, 2021). One prominent barrier point is the transition from traditional k-12 education into postsecondary experiences, and then the successful completion of those programs (Thurston et al., 2017).

Trends in Postsecondary Education for People with IDD

In 2008, the Higher Education Opportunities Act (HEOA) was ratified to provide federal funding to support postsecondary education (PSE) opportunities for people with IDD. Today, over 300 institutions of higher education in the United States offer PSE for students with IDD (Grigal et al., 2021), and nearly 10,000 individuals have participated in the past 12 years (Jackson et al., 2018). The employment opportunities for individuals who complete PSE programs are positive, with employment rates of nearly 70% compared to the national trends of approximately 18% (Domin et al., 2020; Grigal et al., 2023).

While outcomes of participants in PSE programs for students with IDD are promising, there is significant variance in the program models (Grigal et al., 2024). In a 2023 report, Grigal et al. summarized the most recent data on the current federally funded PSE programs for students with IDD, which account for approximately 35 of the 300+ active programs. Students in nearly two-thirds (~26) of reporting programs were enrolled in inclusive courses at a rate of at least 50%. Of all courses taken, 32% of coursework was for official credit, 39% was for PSE program-specific credit only, 11% was non-credit bearing, and 1% were continuing education credits. The the report suggests that 51% of all coursework was connected to students' career goals. Additional research is needed to illuminate *how*, when appropriate, coursework relates to credentials, degrees, or programs offered at the academic institution the connections to fields of interest for students, and industries with growing labor market demands. Given the program variances, the Think College National Coordinating Center has finalized Program Accreditation Standards for Higher Education Programs enrolling students with IDD (Think College National Coordinating Center Accreditation Workgroup and Inclusive Higher Education Council, 2024). These standards will provide guidelines for colleges and universities considering establishing high-quality programs. The model standards will be valuable **for institutions of higher education, as well as**

students with IDD and their families (Think College National Coordinating Center Accreditation Workgroup, 2021).

Access to programs and content. Postsecondary education programs for people with IDD increasingly emphasize career pathways that go beyond entry-level roles, with opportunities for technical skill development, internships, and employer partnerships (Grigal et al., 2021). Programs integrate coursework, internships, and job training to provide students with marketable skills aligned with in-demand fields, such as healthcare, information technology, and education. To promote sustainable careers, many postsecondary education programs are establishing partnerships with employers committed to diversity and inclusion, which helps students gain real-world experience and foster essential soft skills (Plotner & Marshall, 2020). This trend towards comprehensive career preparation is helping to shift perceptions of employment for individuals with IDD, underscoring their potential to contribute meaningfully to diverse career fields.

In a 2020 study, Becht et al. reviewed courses of study at 11 PSE programs for students with **IDD** in Florida. The programs are clustered into three types: liberal arts, career technical, and transition. Liberal arts programs were described as “general knowledge of an array of subjects (e.g., the arts, humanities, natural sciences, and social sciences) rather than specific technical knowledge” (Becht et al., 2020, p. 69). Transitional programs focused on “independence, employability, self-determination, and/or civic participation rather than a specific field or career” (p. 70). The authors described career technical programs as those “designed to instill specific technical knowledge in a chosen vocation field… [and] consists of a series of courses that prepare students for entry-level employment in specific career fields” (p. 69). Within the 11 Floridian career technical programs that responded, opportunities broadly clustered into categories such as health care (e.g., nursing, massage therapy, first aid/CPR), customer service and retail (e.g., ServSafe), and STEM (e.g., welding, engine repair). It’s unclear how many students enrolled in each program, or if there is a connection between the type of programs in which students enrolled and future outcomes. While this study only investigated programs in one state, the data suggest an increasing focus on career-oriented courses.

In another study, Walters et al. (2021) investigated the availability of industry recognized credentials (IRCs) in PSE programs for students with IDD. IRCs are certificates that demonstrate an individual has a specific set of skills or qualifications in specific fields. These credentials ensure people have the necessary technical skills to contribute to their fields of interest and are associated with increased rates of employment. A total of 69 PSE program staff responded to the study with a third of respondents (33%) indicating that students often or always access IRCs, with approximately 23% completing the IRC requirements before exiting their programs. While the data on program type and experiences available is still growing, these studies demonstrate the increasingly career oriented nature of PSE for individuals with IDD. Access to career and technical training involves various strategies to support students' success in acquiring appropriate skills and completing coursework, and IRCs are one of many promising avenues.

Predictors of post-school success. High school students with IDD benefit from activities and services linked to greater post-school success, such as career awareness, paid employment, self-determination/self-advocacy, support networks, and technology skills (Mazzotti, 2020). However, research is still emerging on how these strategies are applied in PSE programs for students with IDD. In 2022, Papay et al. reviewed data of 359 students receiving college-based transition services. They found 11 of the high school predictors to be highly prevalent, or evident in more than 70% of the PSE programs. Examples of predictors with the highest prevalence included parent involvement, peer mentor support, interagency collaboration, and career awareness.

Grigal et al. (2019) investigated the specific predictors of employment success after PSE program completion. Four activities were found to be connected to post-program employment. These included the type of institute of higher education, paid employment during program enrollment, on campus housing, and obtaining a credential/certificate as part of the program. Additionally, when students had paid employment before enrolling in the program, they were more likely to obtain paid employment within 90 days of program completion. Despite the importance of these employment focused activities, implementation varied across the PSE programs (Grigal et al., 2019). For example, students were engaged in activities such as volunteering or unpaid internships rather than paid internships or co-ops.

People with IDD and STEM Education

Though people with IDD have historically had limited access to STEM education and employment, one promising point is the literature emerging on strategies to support students with IDD in accessing STEM content in k-12 settings. Emerging research demonstrates that students with IDD learn STEM content when targeted practices are implemented using a universal design framework (Jimenez et al., 2019; Spooner et al., 2011). For example, approaches that combine explicit instruction with other practices such as video modeling, manipulatives, prompting, and graphic organizers increase learning in areas such as engineering, math, and computer programing (Jimenez et al., 2021; Wright et al., 2020).

While the research on STEM for students with IDD in k-12 is growing, the postsecondary literature that does exist is focused primarily on program descriptions. Lawler, Joseph, & Green (2018) described a non-credit, non-degreed program for students with intellectual and developmental disabilities in computer science and information systems at PACE University. Students take courses in STEM, extracurricular courses, and participate in employment activities such as networking nights and career talks. Rubenzer & Peirce (2023) described a set of “reverse inclusion” postsecondary courses which included a variety of science topics. Students with ID enroll in non-credit courses of their choosing, and degree-seeking students from STEM fields across the university act as peer mentors. Other studies have investigated the use of augmented reality to teach science vocabulary to students with IDD (McMahon et al., 2015), and the discrepancy between technology skills needed in the workplace and the skills taught in postsecondary education (Moore, 2023). Thus, research regarding specific evidence-based practices and predictors of postsecondary success for people with ID, and STEM access for individuals with disabilities more broadly, are an important foundation for investigating barriers and supports.

National efforts are growing to diversify STEM fields, but the availability of these opportunities remains limited, including opportunities that support the technical skills needed for the positions at the forefront of the shifting labor market (Fisher et al., 2022; Schifrer & Freeman, 2021). Additionally, clarity is needed regarding the types of PSE programs, degrees, and credentials available in addition to the specific supports, evidence-based predictors**,** and practices being implemented (Becht et al., 2020; Domin et al., 2020). To our knowledge, no studies have been conducted to investigate the alignment between the PSE opportunities available to individuals with IDD and the increasingly STEM oriented national labor market. Thus, the purpose of this study is to explore the STEM career pathways and credentials available through PSE programs in the United States. The research questions are:

1. What STEM opportunities are available to students enrolled in PSE programs for students with IDD in the United States, and how many students are enrolled or graduated from these programs?
2. What factors influence STEM opportunities and the supports available in PSE programs for students with IDD?

Methods

This study employed an explanatory sequential mixed methods design (Creswell & Plano Clark, 2017) with a scoping survey in the first phase and follow up interviews in phase two to explore PSE opportunities in STEM for students with IDD. A mixed methods research approach was chosen because the integration of quantitative and qualitative methods provides complementary understandings and inferences in response to research questions, which would be limited using either method alone (Greene et al., 1989; Bowen et al., 2017). The explanatory sequential design (Figure 1) provided a means to first investigate the context of PSE programs that do or do not offer opportunities for STEM learning and career preparation, and explore what experiences and/or credentials related to STEM are offered to postsecondary students with IDD across the United States. We chose this holistic approach to provide insights into which components of the PSE programs for students with IDD support STEM pathways, what these opportunities look like, and perceived facilitators and barriers. “Connecting” the quantitative and qualitative data in two sequential phases (Teddlie & Tashakkori, 2009) allowed us to learn from interviews of participants representing PSE programs offering STEM for students with IDD.

[Insert Figure 1 here]

PHASE I: Quantitative Survey Procedures

In Phase I, we implemented a cross-sectional survey of staff representing PSE programs for students with IDD. The initial scoping survey explored which PSE programs provide individuals with

IDD opportunities in STEM, including enrollment numbers and credentials awarded. The survey was developed and piloted by the research team, which consisted of three faculty members, one PSE program staff, and one graduate student. A five-step iterative process was used to construct, pilot, and revise the survey (Buckingham & Saunders, 2004). Feedback on the initial draft was elicited from our institution's PSE program director and faculty outside of the research team with expertise in quantitative research. A revised survey was then distributed to five national PSE experts for a final round of feedback.

The revised survey, approved by our institutional review board, had three sections including (1) characteristics of the PSE program serving students with IDD and the affiliation of the participant representing that program, (2) student enrollment numbers, and (3) information on specific credentials offered to students. Participants were asked to provide information on credentials offered along with the number of alumni and current students that participated in STEM, courses, work-based learning experiences, or other STEM-related experiences. The survey was disseminated using Qualtrics software (Qualtrics, Provo, UT) to the 300+ PSE programs for students with IDD via three national listservs. Survey response data was analyzed using descriptive statistics.

Quantitative Analysis

Out of the 86 recipients that clicked the survey link, 69% of respondents (n=59) consented to participate and provided information on their PSE program with their affiliation. Survey participant responses were organized and cleaned in excel before conducting descriptive statistics in RStudio (RStudio Team, 2019) for preliminary findings. These tentative results were used to identify PSE programs for students with IDD offering opportunities in STEM, which drove participant recruitment in Phase II. The dataset was checked and modified to exclude ineligible participants. The information provided by each program was cross-checked with the Think College list of programs, CTP status of the program, and the program websites. Participants that did not represent PSE programs for students with IDD (e.g., college-based transition programs) were excluded. In two instances, more than one response was provided for an institution; in both cases, only one participant provided complete credential information. The 56 survey responses were analyzed using descriptive statistics.

PHASE II: Interviews

Using a connecting approach to integration, depicted in Figure 1 (Teddlie & Tashakkori, 2009), we identified and recruited eligible survey participants for Phase II of the study. The inclusion criteria for determining which programs offered STEM opportunities included: a) the survey respondent worked in a PSE program for individuals with IDD (high school postgraduate) in two- or four-year colleges or technical institutions, b) the entire survey was completed with contact information and indicating the respondent was interested in participating in further interview, and c) survey responses demonstrated the PSE program provided formal or informal STEM education and employment opportunities to individuals with IDD. Formal and informal STEM opportunities included activities such as the enrollment of students in STEM-related credentials or career pathways, graduates employed in STEM, individualized or work-based learning, and/or STEM credentials or coursework, or other formal and informal STEM-related learning. After the inclusion criteria were applied, 14 survey respondents were eligible to participate in interviews. Of the 14, three participated in the interviews.

We developed a three-part semi-structured interview protocol with questions to verify and expand survey data and findings (Greene et al., 1989). The questions were designed to deepen our understanding of how programs define STEM, what STEM opportunities entailed, document participant's perspective on Phase I survey results, and clarify specific details related to PSE programs. Examples of questions about STEM and related IRCs included: "What is the field [of a specific pathway]? What is/are the job(s) this leads to? What are the skills necessary for an individual to be successful in this pathway? Describe your work-based learning experiences (WBL) (e.g., paid/unpaid internship, co-op), including job title, description, hours? Describe how you partner/work with employers (i.e. How often and in what ways to do communicate with them? How many interns do you have with each employer?)."

The semi-structured virtual interviews were no longer than 60 minutes and conducted in Microsoft Teams. Audio recordings (with interviewee's cameras off) were transcribed, reviewed and edited for accuracy. For member checking purposes (Miles et al., 2018), the transcriptions were emailed to interviewees for review, confirmation, and suggested revisions. Transcriptions were assigned an identifier and uploaded into the qualitative data analysis tool MaxQDA, (Kuckartz & Rädiker 2019).

Qualitative Analysis

Thematic analysis of the qualitative data was performed with a flexible, inductive approach (reflexive TA; Braun & Clarke, 2022) by researchers who work within a PSE program for students with IDD and research assistants less familiar with the professional language. The researchers used an iterative approach to actively develop themes based on the interviewee's reporting of their experience and context (Braun & Clarke, 2022). We relied on a descriptive process that stayed close to the data. This approach allowed flexibility in describing codes responsive to the language of participants, the contexts of their institution and program, and our research questions and theoretical assumptions.

Three members of the research team conducted the initial analysis. After each researcher developed codes, agreement was reached through a series of team meetings where the team refined the codes and descriptions, grouped the codes, and returned to the data to write memos. Using the codes and memos, we identified four themes of shared meaning across the interview participants. We then returned to the data to comprehensively describe the themes, identify subthemes, and use a visual mapping process to discern the relationship between the concepts within and across the data.

Findings

Below, we describe the survey findings of 56 participants in Phase I, including a credential profile from the subgroup of 14 participants from institutions reporting STEM opportunities (see Table 1). Our findings for Phase II address the themes from the interviews (n=3).

Phase I: A Scoping Survey

Participants (n=56) selected their role in the program or job title through a multiple response format followed by the time spent in the position. Of the multiple responses, participants identified themselves as 42 PSE program directors, 7 faculty, 4 support staff, 4 job development/career specialist/employment specialists, and 5 "other" titles not specified. A total of 6 participants selected multiple roles. Time spent in the position was described as less than 1 year (n=10, 18%), 1 year – 4 years (n=22, 39%), 5 years – 10 years (n=6, 11%), and more than 10 years (n=18, 32%). Participants provided information on the characteristics of their university and programs. Table 1 contains program characteristics, including Comprehensive Transition Program (CTP) status.

[Insert Table One Here]

All survey participants were required to identify program characteristics, enrollment numbers, and the total number of credentials offered to students. We also asked respondents to provide information about the specific types of credentials offered. A total of 32 survey respondents provided specific information about the credentials offered within their institutions, and a total of 138 credentials were reported with an average of 4 credentials per program. The specific credential information provided insight into the types of credentials being offered and served the primary purpose of identifying recruits for Phase II of the study (i.e., PSE programs offering STEM).

Credentials and Work Based Learning Experiences

Of the 138 credentials identified, 67 (49%) were described in detail including the title, organization awarding the credential, industry-recognition status, whether instruction was inclusive or specialized, incorporation of work-based learning, and classification of the credential as STEM or not STEM. Table 2 summarizes the details reported for each of these 67 credentials. PSE Credentials were awarded by the PSE program for students with IDD, the Institute of Higher Education, or another credentialing agency or organization such as the National Restaurant Association and Automotive Service Excellence (ASE). At the time of this survey, a total of 80 students were enrolled in 19 (28%) of the 67 available credentials. Average enrollment was 1 student per credential and a median of 0, indicating low enrollment across credentials. Work-based learning opportunities were included in 61 of the 67 credentials (91%), which consisted of paid internships, unpaid internships, co-op experiences, and “other” WBL opportunities. The “other” option was clarified as paid employment, volunteer experiences, and partnerships with Vocational Rehabilitation.

[Insert Table Two Here]

Identified Programs Offering STEM

The research team collaboratively coded each of the 67 credentials as “STEM” or “Not STEM” using definitions from the National Science Foundation career fields (Okrent & Burke, 2021), which includes computer and mathematic sciences, biological, agricultural, and environmental life sciences, physical sciences, social sciences, and engineering. After coding the 67 credentials reported, a total of seven institutions offered 15 credentials that were classified as STEM.

Within the 15 available STEM credentials, students were enrolled in a total of 7, and 22 students were enrolled across these seven credentials. There were 1-2 students enrolled in each of the credentials (median=0). The STEM credentials were awarded by IHEs (n=5), PSE programs for students with IDD (n=1), or other credentialing agencies (n=9). The specific STEM credentials include Automotive Collision Technology Technician (engineering career field), Amazon Web Services (computer sciences), Computer Graphic Arts (computer sciences), Digital Engagement (computer sciences), and Building Trades and Construction Design Technology (engineering).

In addition to the seven PSE programs for students with IDD offering industry recognized STEM credentials, an additional seven programs were identified as offering other STEM opportunities through course audits, informal learning experiences, and/or work-based learning. Thus, 14 survey respondents reported STEM opportunities through formal or informal learning experiences. At the time of this survey, a total of 28 individuals with IDD were participating in these formal and informal STEM opportunities, and an additional 21 had received certificates of completion.

Phase II: STEM PSE Program Interviews

The purpose of the qualitative phase of this research was to gain deeper insight into the factors that influence the STEM opportunities available in postsecondary education for students with IDD, and the supports available within these programs. Using the Methods outlined on p. 11, we identified four themes, summarized in Table 3, which include a) access to STEM, b) learning experiences to support STEM skills and knowledge, c) the role of supports, and d) facing expectations.

Participants. All three interviewees, each of whom is assigned a pseudonym, represent four-year public institutions of higher education. In the first interview, Tony, the director and founder of a mid-size

(11-20 students) PSE program for students with IDD at University A in the Southwestern US, described a program that includes a set of non-credit, continuing education courses. Tony described these courses as a "reverse inclusion" environment, or courses in which individuals with IDD learn alongside peer mentors, including undergraduate and graduate students in STEM and education majors.

In the second interview, Gretchen, a faculty member of a PSE program for students with IDD at University B described a larger program (31 or more students) in the Southeastern US. Young adults with IDD, typically between the ages of 18 to 29, attend the program for two years. Two specialized credentials are offered along with the option to audit the full catalog of courses available on campus. University B is a technical university, attracting students with IDD interested in STEM and encouraging students to audit STEM courses. In addition to courses, students participate in WBL experiences including paid internships, unpaid internships, and co-op experiences. Most students take a STEM course and do at least one STEM-related internship. Gretchen reported 10 students with IDD enrolled in STEM pathways. She knew of at least one graduate employed in a STEM-related career out of the 10 graduates employed and 26 graduates in total.

Whitney is the PSE program director and faculty at University C, a newly developed PSE program for students with IDD at a Western US institution. This mid-sized program (11-20 students) serves students with IDD from ages 18 to 25 years old for a length of 2 years. Students with IDD enroll in program specialized courses, including a course on digital literacy, while also having the option to audit undergraduate STEM-related courses. Credential pathways are not currently offered, but WBL experiences are organized around student interests through internships in STEM-related fields. Whitney describes the program as person-centered with individualized pathways that include STEM. This new program did not have graduates at the time of the interview.

Access to STEM

All three participants mentioned that students with IDD that participated in their program seemed to have had limited opportunities to learn STEM in the past. Three sub-themes were identified related to opportunities including a) the role of k-12 STEM experiences, b) awareness of STEM careers, and c) exploratory experiences in STEM.

The Role of k-12 STEM experiences. One factor that emerged during the interviews is the influence of early STEM experiences on an individual entering postsecondary education. All interviewees described how students with IDD had limited opportunities to learn STEM in formal and informal settings before postsecondary. Whitney at University C stated, “A vast majority of our students who come into the program were excluded from science coursework in K-12 or had, at the most, kind of minimal exposure to science, and the math coursework that they received was very much on a kind of life skills functional curriculum.” Stated differently, Whitney perceived that the focus of early instruction in STEM was on more basic skills related to managing daily aspects of life, rather than more academically challenging coursework such as understanding complex science or math content or exploring STEM careers.

STEM career awareness. The PSE staff who participated in the interviews described how they are beginning to focus on STEM career awareness for their teaching staff, students with IDD, and families/support networks. Both Whitney and Gretchen described the importance of PSE staff supporting students to initially develop early STEM skills such as digital literacy, and furthering or expanding their experiences. For example, Gretchen from University B, described a specific course in which students “explore the technology field” and are introduced to “different employment options.” Similarly, Whitney highlighted the importance of her team “finding positions that are helping (individuals with IDD) to develop skills where there is a career path, so that this [internship] isn't like the job that they're in forever and they’re done, but that there is a way to move forward.”

Tony described the importance of helping students with IDD become aware of and explore their interests in STEM. He described offering exploratory experiences that may not have been offered in the past, and highlighted a set of specialized courses in STEM that provide students an opportunity “to learn for the sake of learning and let them explore topics that they never even thought about. And then from there, you know, then maybe they could explore career options after that.” This exploratory experience may then inform a student’s studies in continuing to pursue STEM or deciding otherwise.

This subtheme suggests that in these three institutions, PSE staff are intentionally providing opportunities in STEM for their students. It also suggests that staff are working collaboratively with students to select STEM opportunities based on their interests and career goals and using the internship as a launching point into long-term careers. The mention of "moving forward" highlights how students in these specific programs are building work skills and experiences focused on career trajectories. These PSE programs for students with IDD are not only expanding to include more STEM experiences, but also focusing on careers with opportunities for growth and upward movement.

Learning Experiences to Support STEM Skills and Knowledge

Interviewees described how students' learning experiences developed STEM skills and knowledge through a) technical skills training and b) work-based learning. Students learned and developed a variety of skills from both types of experiences. Examples of skills include video content creation, science education/teaching, data entry, forestry and GIS, animal sciences, video game design, lab technician skills, engineering technicians, media editing (sound or video editing), automotive services, veterinary care, environmental science, HVAC, math skills, and an understanding of scientific methods.

Technical skills instruction. Technical skills instruction is critical for ensuring people gain access to the skills and knowledge needed for successful participation in STEM careers. Interviewees described three different approaches for providing technical skills instruction including specialized/program-specific courses, inclusive coursework, and subject-specific and focused learning. Specialized courses are courses taught by program staff exclusively for students enrolled in the PSE program to support each students' needs (Think College, 2016). These STEM courses tended to be either exploratory in nature or provide foundational skills related to STEM. Examples included introductory courses like General Technology, Basics of Microsoft Excel, Introduction to Computer Programming, and Multimedia Production. Tony described how special topics surrounding STEM were critical for building interest. For example, he mentioned incorporating math instruction into other courses on basketball and event planning because families and students tend to avoid courses with technical names or a math-focus. Similarly, University C offered a digital literacy course and University B offered a General Technology course targeting foundational computer skills. Some of these specialized courses were credit-bearing while others were offered for continuing education credits that did not count towards graduation.

Interviewees also described inclusive courses available, which primarily involved auditing undergraduate STEM courses. Students chose courses related to their interests, desired skills, and career goals; the students with IDD learned alongside traditionally enrolled peers, typically in introductory courses. Whitney told a story about a student that audited introductory computer science courses and then went on to traditionally enroll in the university as a computer science major. Examples of inclusive courses mentioned by participants included Introduction to Computer Science and Environment Science.

Subject specific training is often a part of formal pre-apprenticeship and apprenticeship experiences and includes coursework specifically aligned to an industry recognized credential or badge. These experiences include enrolling in online coursework to learn specific skills, taking short courses through open access websites, and job specific training offered through companies. For example, Gretchen from University B described specific training related to forklift operations that was part of a targeted OSHA training series. A variety of STEM skills/knowledge were targeted across the different formats. For example, students learned video content creation, science education/teaching, data entry, forestry and geographic information systems, animal sciences, video game design, lab technician skills, engineering technicians, media editing (sound or video editing), automotive services, veterinary care, environmental science, HVAC, math skills, and an understanding of scientific methods.

Work-based learning. In addition to technical skills instruction, interviewees described the importance of work-based learning, which incorporated on the job training to develop critical STEM skills and knowledge. Individualized training, mentoring, employer training, accommodations, job coaches, natural supports, and workplace accommodations were critical components of work-based learning experiences. Strategies to support the development and implementation of WBL included community networking, strong and sustainable partnerships with employers, and identifying “champions” that helped cultivate opportunities in STEM. Additionally, participants highlighted the importance of tapping into existent internship, volunteer, or co-op services on campuses to increase WBL placements.

Interviewees described mentoring to target individualized skill instruction to address specific, subject-based skills and knowledge as part of the WBL opportunities. Typically, this type of instruction occurred in response to an individual student's need related to a knowledge or skill gap. After identifying specific gaps in knowledge or conceptual misunderstanding, missing background knowledge, or the need to develop very targeted skills, program staff would develop individualized, targeted interventions that involved directly teaching skills or concepts in addition to coaching. For example, job coaches provided additional training on targeted topics, program staff and students engaged in weekly check-ins, and systematic plans were implemented to promote students' independence.

The Role of Supports

All interviewees emphasized the critical role of supports to increase access to STEM for individuals with IDD; additionally, they suggested that their program staff play a critical role in coordinating these supports. We identified four sub-themes from the interviews related to further illuminate the supports necessary for success. These include a) individualized programing, b) student support networks, c) strong community partnerships, and d) PSE program efficacy.

Individualizing programing. Individualizing programs and STEM opportunities for each student was mentioned by all participants. Frequent communication with students was essential for programs to individualize access to STEM pathways; the individual, program staff, and employers needed to understand interests, motivations, and support needs to create high quality experiences. The interviewees highlighted how lack of communication was a barrier for providing students with the necessary support. For example, Gretchen, from University C, stated that, "sometimes once the support is not necessarily working for them, or like automatically provided, they tend to not necessarily ask for the support when needed. And also, they don't know what support they might need."

Whitney (University B) and Gretchen (University C) both provided additional information about the role of PSE staff in coordinating individualized supports. They suggested that having staff who individualize employment supports was critical. Whitney stated, "we have a full-time post doc who oversees our employment services… it's kind of all hands-on deck with the other graduate assistants who are in [our program] and the faculty advisors to get needs met." Similarly, Gretchen described how program staff assist students in selecting appropriate courses and organize the out of class resources (e.g., additional instruction) to individualize experiences.

Student support networks. Student support networks focused on relationships in courses, work, and home environment, and were designed to proactively address challenges. Gretchen described challenges related to building inclusive STEM opportunities. She stated that students with IDD attend University B because of their interest in STEM, but then "they have a lot of trouble feeling a sense of belonging and that they can have a meaningful part in those fields." Though opportunities were growing, students needed explicit, intentional supports to promote a sense of belonging.

The network structures varied across programs, but all provided students with specific support and encouragement, assisted in advocating for a student's needs, supported the design of individualized programming, and/or act as a support for courses, internships, and other learning experiences. Tony (University A) described peer mentors or volunteers who supported students during specific classes, and Whitney (University B) described how other employees in individual workplaces provided support. Gretchen (University C) mentioned the importance of mentors and tutors as members of a strong support network for students. She stated, "If they have a good support network, or like, somebody who works with them, that could be a little bit more of a mentorship situation." On-the-job training, tutoring, and mentorship in WBL experiences are example sof supportive relationships. Family involvement was a support mentioned by Tony (Univeristy C); he described some parents and guardians as strong advocates supporting students in communication and course selection.

Community partnerships. This subtheme on developing strong community partnerships involved programs utilizing a community and industry network to connect with employers. Through these connections, programs identified and coordinated opportunities already available in the community such as WBL experiences and other STEM learning and training. Interviewees highlighted that employer and community partnerships are critical for accessing STEM career paths that are individualized and accommodating for students. At University C, Whitney explained that their program does initial job training of students and then on-site support of WBL: “Staff just support them [the student] to support the employer, but they fade pretty quickly. And then it's just regular check-ins throughout the rest of the internship. Unless something comes up, or a new skill needs to be taught, or a problem arises.” Strong partnerships rely on open communication with employers hosting students with IDD in the workplace to ensure agreed upon expectations and accommodations for the student.

Program efficacy. Though resources varied across institutions, five common facilitators to PSE program efficacy emerged. Participants highlighted the need for well-trained staff to provide adequate levels of support, funding for scholarships, access to STEM career pathways and WBL experiences, and partnerships with agencies such as vocational rehabilitation. Sufficient resources were described as beneficial to PSE programs in terms of variety of opportunities offered, scholarships, course curriculum, and hiring. Tony mentioned increased staff capacity through hiring and training, and utilizing scholarships to expand attendance. Additionally, Whitney highlighted insufficient resources as a barrier She described barriers in obtaining transportation for students commuting to campus from rural areas or traveling for WBL, while Tony described the risk of policy changes interrupting federal and state funding.

Facing Expectations

Throughout the interviews, participants consistently mentioned the influence of expectations on developing STEM education and employment for people with IDD. Three specific subthemes emerged related to expectations including a) the role of attitudes and biases toward individuals with IDD in STEM, b) the concept of pigeon-holing, and c) funding barriers.

Attitudes and biases toward individuals with IDD in STEM. Attitudes toward STEM, family involvement, and perceptions of a student’s abilities in STEM related fields emerged in each of the interviews as factors influencing career and course selection. Tony at University A described many instances of low expectations from educators, intervention specialists, parents, undergraduate students, and research administrators. He stated, “the chief limiting factor for getting the students to sign up for the classes seems to be their parents, and their parents' attitudes about STEM.”

Across the interviews, participants highlighted the limited information families and educators receive about the possibility of STEM education and careers for people with IDD, and how powerful it can be to share even small stories of success. For example, Tony stated that many people have a “limited viewpoint of what adults with IDD can do”, but that their attitudes change when they see people being successful. He shared a story about what happened when one of his students obtained an internship and eventually employment in a neurogenetics lab; family members began asking for more opportunities such as internships after witnessing the student’s success. All three interviewees described how families “attitudes about STEM” acted as a facilitator or barrier for individuals with IDD.

In addition to family and educator perspectives, interviewees also described employer attitudes and beliefs as influential in STEM experiences for people with IDD. Whitney stated that “bias and misconceptions on the part of employers about what people with IDD can do” significantly affected the work-based learning and employment opportunities available. All interviewees described instances of STEM employers expressing concerns about hiring or training students with IDD. Whitney described the tendency of employers to place students in clerical or inventory work.

Gretchen, however, provided a different perspective on this practice. She considered the clerical jobs within STEM environments to be STEM careers. She highlighted how each student requires different types and levels of support from employer partners who tend to be open-minded and supportive, particularly in research labs on her campus. She describes a specific incidence in which an employer provided a work-based learning experience/unpaid internship, which allowed the employer to determine the strengths and needs of the student and implement supports to meet the individual needs of the student.

Pigeonholing. Related to beliefs and attitudes, participants mentioned the concept of pigeon-holing. Pigeonholing referred to the practice of automatically assigning people with IDD to educational experiences that lead to low-skill, low pay employment. Interviewees reported that the expectations for individuals with IDD tended to be low, regardless of the strengths and support needs of the person, and these low expectations guided decisions about specific people and experiences.

Tony described how the concept of pigeonholing seeped into system level decisions, creating challenges such as securing funding for projects or research. He specifically shared an experience in which a project for expanding STEM internships in laboratory settings was rejected and a grant reviewer expressed bias in writing. Tony stated:

> [It] is not on their [funding reviewers'] radar screen to help adults with IDD to get into science. Some reviewers were very positive. One reviewer said, 'I don't believe that they [people with IDD] can do this.' They [the reviewers] actually wrote that, which is weird because we've been doing this for a long time, and we've published papers with them [adults with IDD].

This example demonstrates how bias enacted through institutional structures might contribute to pigeonholing in ways that spillover into what opportunities are offered**.**

Discussion

Science, technology, engineering, and mathematics (STEM) industries are continually evolving, including the growing need for highly skilled employees who represent diverse backgrounds and ways of thinking. Historically, many STEM careers have required four-year degrees, but opportunities for individuals with other credentials and specific skills have been growing. At the same time, there is an increasing focus on diversifying the STEM workforce and reaching the "missing millions" (Blatecky et al., 2021, p. 1). This group includes women, people of color, and those with disabilities — but individuals with intellectual and developmental disabilities are typically not included in diversification efforts.

Including individuals with IDD in STEM education and employment is important for many reasons, some of which include promoting diversity of thought, addressing growing workforce demands, and increasing opportunities for well-paid employment in positions with clear career trajectories. The purpose of this study was to explore the opportunities for STEM career experiences available in PSE for individuals with IDD. We asked, a) What STEM opportunities are available to students enrolled in PSE programs for students with IDD in the United States and how many students are enrolled or graduated from these programs, and b) What factors influence STEM opportunities and the supports available in PSE programs for students with IDD?

In phase one, 56 PSE programs participated in the study, and 14 reported coursework, work-based learning, and/or mentoring opportunities focused on STEM. Similar to the report from Grigal et al. (2024), the opportunities described in each program were diverse, with some offering formal coursework or credentialing and others focused on informal experiences. Across the 14 programs, there were a total of 28 students enrolled in the STEM experiences. The reporting institutions in the current study primarily clustered in two- and four-year colleges and universities, similar to the Becht et al. (2020) findings, with only about 18% of total respondents from career or technical education.

While the exact reason for the low number of programs is not known, several factors could be at play. First, people with IDD have not historically been included in STEM diversification efforts (Fisher et al., 2022; Shifrer & Mackin Freeman, 2021). Additionally, the role bias plays in access was discussed in all three interviews. For example, the interviewees discussed how the attitudes of employers, educators, and families/support networks influenced access to and involvement in STEM. Finally, many students with IDD do not come to higher education in search of STEM careers (Shifrer & Mackin Freeman, 2021). Though evidence-based instruction in STEM is becoming increasingly available in k-12, educators, families, and individuals often do not know careers in these fields are an option.

The results of the combined analysis provide insight into the factors that influence the implementation of and the supports available for students with IDD. Four themes emerged: a) access to STEM, b) learning experiences to support STEM skills and knowledge, c) the role of supports, and d) facing expectations, with subthemes within each. The role PSE program staff awareness and knowledge plays in the development of STEM pathways was clear in this study. It has been less than 20 years since the Higher Education Opportunities Act was ratified to provide financial support for the development of PSE programs for students with IDD, and the number of programs has grown substantially. The field is evolving to focus on credentials, careers with upward trajectories, and access to high level curriculum (Becht et al., 2020; Grigal et al., 2021; Grigal et al., 2022). As PSE staff increase awareness of STEM career opportunities and strategies for supporting students to successfully complete programs, the number of individuals with IDD who obtain employment in STEM fields will grow.

Limitations

There were several limitations in this study. First, the study was implemented after the start of the COVID-19 pandemic, potentially affecting survey findings and response rates. Interviewees typically referred to information through a before and during the pandemic lens. As a result, we suspect the data, such as the enrollment numbers provided by programs, are influenced by effects of the pandemic on experiences such as coursework and work-based learning availability. Relatedly, in the short time since we conducted this study, PSE programs and labor market demands have continued to evolve. There are now more than 350 PSE programs in the United States for people with IDD (Think College, n.d.), which means the 56 respondents represent less than 20% of current programs.

This study was exploratory in nature, with a primary purpose of providing an initial scan of the existing STEM opportunities for individuals with IDD in PSE. As such, we assumed participant accuracy and honesty in both the phases, focusing on patterns across the data rather than the validity of individual responses. We employed procedural remedies (Vomberg & Klarmann, 2021) by confirming participant roles and conducting follow up interviews with a small group of participants, and the results should be interpreted through this lens. Additionally, all participants listed the number of credentials available, but only 32 provided specific information on the exact nature of each, which was a result of the structure of the study. It is possible that other STEM credentials were available for which specific information was not provided.

Finally, we did not collect any student level information such as demographics, grades, prior experiences, support needs, etc. For example, though the interviewees discussed limited previous experiences and opportunities during k-12, we do not have specific information about the previous courses students completed. This information could inform future program design and illuminate the types of experiences necessary for preparing students for STEM.

Next Steps for Research

Together, the survey and interviews provide insight into future research. First, the landscape of PSE for individuals with IDD is rapidly evolving. Career and Technical Education opportunities for individuals with IDD are on the rise (Hyatt & Andrews, 2023). Many of these programs have strengths in STEM, which could translate to increased engagement for students. Additionally, the Accreditation Standards (Think College National Coordinating Center Accreditation Workgroup and Inclusive Higher Education Council, 2024) were finalized since the study. Research investigating the influence of these changes on STEM for individuals with IDD is important.

Research is also needed to provide detailed information about the existing formal and informal opportunities, and how these align to local and national labor market demands. Information about how opportunities vary across institutions, and how these variances influence outcomes will be important. Relatedly, our understanding of the role of k-12 predictors of postsecondary success within PSE programs for students with IDD is only emerging (Grigal et al., 2019). In previous studies, common predictors included parent involvement, peer mentor support, interagency collaboration, and career awareness (Papay et al., 2022). Additionally, paid employment during a program and obtaining a credential/certificate as part of the program (Grigal et al., 2019) were closely associated with employment. The themes in our study were clearly connected to these predictors. For example, career awareness, paid employment, and earning credentials/certificates were components of all the programs, but we did not investigate the role these play in advancing outcomes in STEM. Investigating the application of the predictors in STEM for students with IDD and how these practices are being applied to specific career pathways could illuminate the relationship to long-term employment.

Within our study, PSE programs for students with IDD were often tasked with finding, and in some cases creating, opportunities for students with IDD to gain experience in STEM. This required a great deal of interagency and community collaboration, but the exact role of each stakeholder group remains unclear. It appears there is a relationship between PSE program staff knowledge of STEM, the k-12 predictors, and the availability of programs and supports within these programs. Additional research exploring these relationships and the influence on student opportunities would be valuable.

Implications for Practice

This exploratory study offers important implications for practice in both k-12 and postsecondary education. It is critical that k-12 educators are aware of the opportunities for students after high school and use this information to a) inform students with IDD and their support networks, and b) cultivate learning experiences that prepare students for these opportunities. Though there is evidence that access to STEM is increasing for students with IDD during the k-12 years, additional efforts to broadly disseminate these practices are critical. As Shifrer and MacKin Freeman (2021) highlighted, experiences and coursework in high school influence attitudes and opportunities in postsecondary education. At the postsecondary level, increasing program staff awareness and knowledge regarding STEM opportunities and how to support students in accessing these opportunities is critical. All three interview participants highlighted the essential role of early experiences in exposing students to STEM. Additionally, program staff play a critical role in creating meaningful support networks, developing employment opportunities, and supporting students in making progress toward their goals. While this is similar to non-STEM fields, developing distinct approaches in highly technical fields is important.

Concluding Comments

Students with IDD are increasingly accessing postsecondary education after graduating high school, but there has been limited clarity about the kinds of programs available and how they align to existing labor market demands. One field with steadily growing employment demands is STEM, which not only offers a rising number of employment opportunities but also some of the highest wages. The purpose of this study was to investigate STEM career pathways available to students with IDD across PSE programs for students with IDD in the United States. We were especially interested in understanding the factors that influence the availability of structures and supports within these programs. Though the number of opportunities is somewhat limited, programs are becoming increasingly available, and staff are working to apply evidence-based predictors to promote employment.

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Table 1

Characteristics of PSE Programs for Individuals with IDD and Subgroup of Programs Offering STEM

Program Characteristic	All participants (n=56)	PSE Programs Offering STEM (n=14)	
	n (% of 56)	n (% of 14)	Percent of Total
Institutional Status			
Public Institution of Higher Education	51 (91%)	14 (100%)	27%
Private Institution of Higher Education	5 (9%)	0 (0%)	0%
Type of Institution			
Two-year Community or Junior College	12 (21%)	2 (14%)	17%
Four-year College or University	34 (61%)	7 (50%)	21%
Technical or Vocational Trade School	6 (11%)	3 (21%)	50%
Two-year Community or Junior College and Technical or Vocational Trade School	4 (7%)	2 (14%)	50%
Comprehensive Transition and Postsecondary Program Status	35 (63%)	7 (50%)	20%
Length of program			
1 year	3 (5%)	2 (14%)	67%
2 years	16 (29%)	5 (36%)	31%
3 years	8 (14%)	1 (7%)	13%
4 years	8 (14%)	2 (14%)	25%
Other length	4 (7%)	1 (7%)	25%
Varies depending on the student	17 (30%)	3 (21%)	18%
Size of Program			
1-10 Students	19 (34%)	3 (21%)	16%
11-20 Students	20 (36%)	4 (29%)	20%
21-30 Students	8 (14%)	3 (21%)	38%
31 or more Students	9 (16%)	4 (29%)	44%
Provided Information on Specific Credentials	32 (57%)	10 (71%)	31%

Table 2

Profile of 67 Credentials Offered by 32 PSE Programs for Students with IDD

Credential Descriptor Category	*n*(%)
Award provider/accreditor	
Institution of Higher Education (IHE)	43 (64%)
PSE Program for students with IDD	6 (9%)
Other credentialing agencies	18 (27%)
Industry-Recognized Credential (IRC)	32 (28%)
Attendance exclusively students with IDD	28 (42%)
Incorporates work-based learning (WBL) experience	61 (91%)
Type of WBL experiences	
Paid internships	41 (61%)
Unpaid internships	46 (69%)
Co-op experiences	19 (28%)
Other	16 (24%)
Credential Identified as STEM	15 (22%)
Number of PSE Programs for Students with IDD Offering a STEM Credential	7

Table 3
Qualitative Themes and Subthemes

Access to STEM	**Learning Experiences to Support STEM Skills and Knowledge**
• Role of k12 experiences • STEM career awareness	• Technical skills instruction • Work-based learning
The Role of Supports	**Facing Expectations**
• Individualized programming • Student support networks • Community partnerships • PSE program efficacy	• Attitudes and biases • “Pigeonholing” of students with IDD

An Exploratory Investigation the Postsecondary STEM Opportunities for People with Intellectual and Developmental Disabilities in the United States

Figure 1

Explanatory Sequential Design and Inclusion Criteria for PSE Programs Offering STEM