# Quantifying Difficulties of University Students with Disabilities

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## Abstract

Students with disabilities experience more than the usual number of challenges in their postsecondary education experiences. Students with disabilities typically receive support services from an administrative unit assigned to assist them. But these assigned administrators and their staff often have difficulty identifying the factors that are most useful to support the academic and adjustment success of students with disabilities. This research project aimed to identify the specific factors that are predictive of reduced school retention and graduation rates in students with disabilities. To this end, the researchers used ten years of data (2004-2013) from a large urban university. The data set contained 2,578 students of disabilities with relevant individual school-linked variables which were analyzed using quantitative statistical tests. The type of recorded observations included those from the research literature which were deemed most likely to answer the important research questions.

*Keywords: disabilities, postsecondary, predictors, graduation, grade point average*

A major aim of higher education in postsecondary academic institutions is for all students to succeed, including students with disabilities. Colleges and universities have a distinct responsibility to optimize the learning experiences of students with disabilities. Such students experience more than the usual number of challenges, some of which pertain to their specific disabilities. Students with disabilities typically receive support services from an administrative unit assigned to assist them. But these assigned administrators and their staff often have difficulty identifying the factors that are most useful to support the academic and adjustment success of students with disabilities.

This research project aimed to identify the specific factors that are predictive of reduced school retention and graduation rates in students with disabilities. To this end, the researchers used ten years of data (2004-2013) from a large urban university. The data set contained 2,578 students of disabilities with relevant individual school-linked variables which were analyzed using quantitative statistical tests. The type of recorded observations included those from the research literature which were deemed most likely to answer the important research questions. It is hoped that such answers could then be used to develop a possible model for prediction and for future intervention.

## Literature Review

To understand past research about the college experience of students with disabilities, the literature review examined research indexed in ERIC, PsycInfo, Web of Science, Academic Search Complete, ProQuest Dissertations and Abstracts, and national databases with information on college students with disabilities. Research was drawn from 2009-2018 with a few older seminal studies included. Key words were students with disabilities, disability-related terms, postsecondary terms, retention, and graduation rate. Most assessed studies used qualitative research methods. Most focused on either one disability or one cluster of factors (e.g., impaired socialization). Furthermore, most studies had a limited sample or did recording during a short time frame. To fill this research gap, studies are needed that provide a longitudinal perspective, a university-wide scope, and a quantitative research methodology.

Increasingly, more students with disabilities attend postsecondary institutions. Yet their rate of

postsecondary institutional enrollment lags behind those students without reported disabilities (Hudson, 2013; Joshi & Bouck, 2017; Kilpatrick et al., 2017; McGinty, 2017). A 2011 national survey reported on their types of disabilities. These included: learning disabilities 31%, ADHD 18%, mental-related 15%, and health-related 11% (Raue & Lewis, 2011). Among those students who received special education services in high school, 59% enrolled in postsecondary institutions, as compared to 72% of students without reported disabilities. Of those students with disabilities enrolled in four-year institutions, 45% of them earned a degree or post-bachelor credentials, compared with 37% who enrolled in two-year institutions (Hinz, Arbeit, & Bentz, 2017). For students without disabilities the percentage of bachelor degree completion was higher.  It was 65% for four-year public institutions 76% for four-year private institutions, and 38% in two-year institutions (Shapiro et al., 2017). However, the picture is far more complex.

In terms of external factors, students with disabilities identified the following areas of challenge: registration, academic rigor, faculty treatment, poor support services, and finances. Factors for college success included use of university support services (especially during the first year) and using arranged accommodations (e.g., notetaking aids, extended time for testing), personalized registration process (selecting courses and faculty), and family support.

**Challenges Facing Students with Disabilities**

Students with disabilities have to deal with the same kinds of challenges as other college students, such as academic rigor, social connections, finances, and unexpected situations. However, students with disabilities often need extra help because of their physical, mental, or developmental differences. At the same time, they might not want to disclose their disability because it could negatively affect those universal factors, such as social connections.

Hong (2015) analyzed the "reflective journals" of students with disabilities to identify the writers' daily barriers and frustrations in higher education. Four major themes emerged: faculty perception of students with disabilities, advisors' mismatch, college stressors, and the quality of support services. Kilpatrick et al.'s 2017 study also mentioned the mismatch of needed and received services, as well as staff training gaps, and a one-size-fits-all approach. Howe (2013) echoed Hong's findings that students with disabilities faced academic difficulties in part because of the poor quality of support services.

Thompson-Ebanks (2012) discovered a dynamic interaction between individual factors (e.g., feelings of adequacy, sense of belonging, expectations and perceptions of college) and environmental factors (e.g., expectations of family, college and community systems). For example, if a student felt adequate but college expectations were higher, students might not seek the accommodations they needed (Weatherton, Mayes, & Villanueva-Perez, 2017). Thurston, Shuman, Middendorf, and Johnson (2017) noted that academic personnel lacked knowledge and understanding of students with disabilities, and sometimes held negative stereotypes. Weatherton et al. (2017) also found that engineering and law faculty were less willing than other faculty to provide accommodations; their negative attitudes led to a climate that was counter to inclusivity. Another example of this dynamic interaction was identified by Waale (2017); students with financial challenges had to balance the time demands of work versus studying, especially if they had to complete remedial courses prior to earning college-bearing credits.

Students with visible disabilities had an easier time adjusting to college than students with invisible disabilities; students with emotional or behavioral disorders had the most difficulty with both adjusting to college and gaining help-seeking skills (Bueno, 2017; Pingry O'Neill, Markward & French, 2012). Jorgensen, Budd, Fichten, Nguyen, and Havel (2018) and King (2014) found that students with mental health disabilities were less likely to be retained or to graduate than students with learning disabilities. Jorgensen et al. (2018) also noticed that the former group tended to be older, more likely to be female, have worse personal circumstances, and felt more socially isolated on campus; they were also less likely to register for support services for students with disabilities.

Students with Autism Spectrum Disorder (ASD) faced academic, organizational, social, emotional, communication, and self-advocacy challenges (Howe, 2013). Furthermore, they sometimes needed support services for registration, testing, transportation, and housing (Cox et al., 2017; Cullen, 2015; Hillier et al., 2018). At the same time, students with ASD experienced a tension between self-disclosure of their disorder or asking for accommodations as they were developing their internal identity. They were aware and were influenced by others' perceptions so might not have wanted to embrace ASD as part of their public persona (Cox et al., 2017).

Students with Attention Deficit Hyperactivity Disorder (ADHD) and/or learning disabilities struggled with poor time management, organization, study habits, and social skills (Singley, 2018). In a study by Gleckman (1992), students with learning disabilities

(LD) showed more psychological distress than others. Those most at risk had more academic, personal, and family problems in the past, and tended to be diagnosed later than well-functioning LD students so had fewer opportunities for support services.

Students with disabilities were less likely to major in STEM because of lack of academic preparation and counseling (Groah et al., 2017). However, military veteran students tended to major in STEM because of prior experience, and they were less likely than other students with disabilities to request services either because of lack of awareness or feared the stigma of a self-disclosure label.

## Factors for College Success of Students with Disabilities

As with challenges, predictive factors for college success included both internal and external factors. In some cases, the student's own behaviors impact their success, which they can probably work on. They might also have characteristics that they cannot change, such as ethnicity or parents' education. Internal factors also apply to a higher education institution, such as services, which could be changed. External factors can consist of external funding sources, legal and political regulations, or community demographics.

As an example of an internal factor, Pingry O'Neill et al. (2012) found that female students were 1.5 times as likely than males to graduate, controlling for personal characteristics and disability services. Koehler (2013) found that higher reading achievement was positively significantly correlated with college attendance. Similarly, higher math achievement was positively significantly correlated with the number of credits successfully taken per term.

Use of university support services contributed significantly to the academic success of students with disabilities (Howe, 2013; McGregor et al., 2016). National statistics about support services (Raue & Lewis, 2011) reported the following typical offerings: extra exam time 93%, notetaker 77%, faculty-provided notes 72%, study skills 72%, alternative exam formats 71%, and assistive technology 70%. It should be noted that support services for students with disabilities requires students to self-disclose their disability, unlike in K-12 settings. In a study of 14,000 undergraduate students at a large research university, Hudson (2013) discovered that students who disclosed their disabilities within the first year of enrollment had higher graduation rates than students who self-disclosed later to the extent that for every year that a student delayed disclosing a disability, the length of time to graduate increased by almost half a year. Students with cognitive disabilities and males took longer to graduate.

## Impactful Interventions

In identifying factors that predict student attrition, Davidson, Beck and Milligan (2009) found institutional commitment to be the best single predictor for student retention. Several studies emphasized the need for institutional integrated, comprehensive services that are both inclusive as well as provide overall disability and disability-specific support. Furthermore, such support services should connect with outside agencies (Kilpatrick et al., 2017). Studying a similar approach, Hodge (2017) reported how students with disabilities who received student support services had higher GPAs, retention, and graduation rates than students with disabilities who did not receive these services. In several studies, students cited a number of reasons that they did not use support services for students with disabilities: lack of awareness, lack of knowledge as to the physical location of the services, felt stigma of self-disclosing their disability (Groah et al., 2017; Jorgensen et al., 2018; Thurston et al., 2017).

Another popular intervention was academic coaching (Singley, 2018). This intervention significantly increased academic engagement, knowledge and use of learning and study skills, self-efficacy, and academic success of students with learning disabilities or ADHD. Similarly, peer mentoring can impact student success (Siew, Mazzucchelli, Rooney, and Girdler 2017). Students with ASD who enrolled in a peer mentoring program gained social support, lessened their apprehension of communicating, and helped them manage their academic work. The mentoring motivated the students and provided practice group and emotional support. Deaf students from minority communities were paired with a mentor who was either deaf or familiar with the deaf community. Mentoring was successful when it involved deaf community social capital, asking for accommodations, and communication access. Mentors should also get cultural competency training (Braun, Gormally, & Clark, 2017).

In sum, many studies demonstrated the positive significant difference that campus support services and their resources for students with disabilities had on those students' academic success, especially if started the first year (Hillier et al., 2018; Hodge, 2017; Hudson, 2013) and continued throughout the students' lifecycle (Kilpatrick et al., 2017). Because so many students do not know about these services, or their location, support services need to pro-actively reach out to the entire academic community and

feeder schools to publicize their services (Kilpatrick et al., 2017; Thurston et al., 2017). They also need to minimize the fear of stigmatization and focus on students' needs rather than their diagnosis (Cox et al., 2017; Jorgensen et al., 2018). Furthermore, while providing support services is a necessary condition, it is not sufficient; those services should be comprehensive, coordinated, inclusive, and of high quality (Cox et al., 2017; Hong, 2015; Howe, 2013; Seale, 2006). Not only should all support staff be well trained, but disability-specific experts are also needed (Kilpatrick et al., 2017). Furthermore, the services themselves should be monitored regularly to insure sustained quality and improvement. These efforts also require university support (Moriña, López-Gavira & Morgado, 2017) through allocation of human and material resources, funding, and supportive policies and practices (Seale, 2006).

## Methodology

This research project aimed to identify the specific factors that are predictive of reduced school retention and graduation rates in students with disabilities. To this end, the main research question was: What variables significantly relate to the duration of enrollment in good standing and the graduation rate of students with disabilities as a group? A secondary question was: What variables significantly relate to the reduced school retention and lower graduation rate of college students in relation to their specific disabilities?

### Data

To answer the research questions, the researchers obtained two data sets from a large urban comprehensive university, with IRB approval. The number of students with reported disabilities rose from 467 (out of 31,342 total student enrollment) in 2004, reflecting 1.5%, to 1,575 (out of 38,310 total student enrollment) in 2013, reflecting 3.46%. The two data sets included more than 200,000 observations of all undergraduate students who entered as first-time freshmen, enrolled between fall 2004 and fall 2013. Both data sets captured information about the same students, but one data set had mainly demographic student information that didn't vary over time, and the other data set had mainly non-demographic student information that varied over time each semester of the students' academic career. The variables associated with each student thus formed the basis for analysis: that is, demographics, academic status, and parents' education.

From the merged data set, a subset of only the students with reported disabilities was used, which consisted of 2,578 observations. The data set factors included more than thirty variables. These included demographics, parent education, majors, type(s) of disabilities, disability services used, financial aid (yes or no), veteran status, number of units taken, GPA, and academic status (continuing, discontinued, academic withdrawal, graduated). The data sets were merged, cleaned, and aggregated. In most cases where variable values were missing, the statistical analysis did not include that case. For financial aid and veteran status, it was assumed that if the student did not answer the question, the status was no.

### Statistical Analysis

Once the data set was ready for analysis, quantitative statistical tests (e.g., chi-square test of independence and binary logistic regression) were used to identify significant predictor variables related to the duration of satisfactory academic enrollment and the graduation rate of students with disabilities. Multiple two-sided proportional comparison tests of categorical variables (e.g., gender, parents' education, major departments, types of disability, types of services, ethnicity) were employed and were accounted for using a Bonferroni adjustment. Consequently, the $p$ values were adjusted to take this into account. In addition, binary logistic regression analysis was done to model the relationship between predictor variables and the binary dependent variable.

## Findings

The university's data set provided a rich picture about students with disabilities over the time period of 2004 to 2013. Findings showed the types of disabilities that students self-reported and the types of services that they received. Data also indicated demographics, parents' education, and academic status of students with disabilities. Details about these findings and associated statistics follow.

An average of about 3% of the university's population identified themselves as having one or more disabilities (average over the ten years, rising from 1.49% in 2004 to 3.95% in 2013). Over the decade, the leading disability reported was learning (25%), followed by ADHD (21%), hearing (13%), psychological (13%), and mobility (10%) (Table 1).

It should be noted that the state's data collection agency refined the categorization of disabilities in 2010 such that the term "other" disabilities, was dropped, replaced by the specific addition of ADHD, ASD, brain injury, communications disabilities, and psychological disabilities. In that respect, the decade totals underrepresent ADHD, and psychological dis-

orders. As Figure 1 shows, the number of students reported having ADHD increased in numbers more than the other reported disabilities from 2010 to 2013. The number of students who self-reported psychological disorders also increased in number during the same years. The number of students who reported other disabilities remained stable over the decade. In the final year, 2013, the number of students with reported disabilities ranked in order as follows: ADHD (highest number), learning disability, psychological disorders, hearing impairment, mobility limitations, other functional limitations, ASD, visual limitations, brain injuries, and communications disabilities.

Over the 10-year span, the most frequent services for students with disabilities consisted of counseling, testing accommodations, registration help, and interpretative services. As Figure 2 shows, testing increased threefold, interpretative services remained stable, and registration help and counseling significantly decreased.

In terms of ethnicity, the relative percentages of students with disabilities and their types of disabilities are shown in Table 2. White students are over-represented in terms of the percentage of students with reported disabilities, constituting 51% of that population while representing only 23% of the total student body. Almost a quarter of white students reported having a learning disability (the most frequently reported disability for them). Asian students were slightly underrepresented among students with disabilities, constituting 7% of that population while presenting 11% of the total student body. A third of them reported a hearing impairment (the most frequently reported disability for them), followed by about a quarter of them reporting having ADHD. Hispanics constituted about a fifth of the students with reported disabilities, with learning disabilities leading the type of disability reported. More than a third of African Americans with disabilities, who constituted 7% of the total number of students with disabilities, reported having a learning disability. Only 1% of the total student body – and 1% of students with disabilities – were Native American/Pacific Islanders; about a third of them reported having ADHD and a quarter of them reported having a learning disability.

Table 3 details the final grade point average (GPA) and graduation rate of students with disabilities, linked to various variables. Several variables were tested with chi-square statistics. For instance, the table reveals the importance of the first semester for students with disabilities. Students who stayed beyond that first term were much more likely to graduate ($p<.001$); past that first term, the fall-off rate was much less. Similarly, students who took 6 or fewer units their first and last semesters were significantly less likely to graduate ($p<.01$). More specifically, students with hearing impairments were much more likely to leave after one semester, 27%, than students with other disabilities; the second highest percentage was 10% discontinuance by students with Autism Spectrum Disorder (ASD). While the overall percentage of students with disabilities who graduated was 64%, cumulative GPA and graduation rates were significantly lower for students with ASD (2.37 cumulative GPA and 43% graduation rate) or hearing impairments (2.31 cumulative GPA and 46% graduation rate) even after controlling for the first semester drop outs. Multiple proportion chi-square statistical analysis found that students with these two disabilities graduated at a significantly lower rate than students with any other specific disability ($p<.01$ for hearing impairment and $p<.01$ for ASD).

Table 3 also shows that for the first semester, students using interpreter services (for hearing impairment) had a significantly lower GPA than other services ($p<.01$), although that difference disappeared if students did not drop out during the first semester. Students who received registration help were more likely to have a lower cumulative GPA and to discontinue ($p<.01$) (which might mean they needed more help in general). By the end of their program, students who did not use services took more units and had a cumulative GPA that was significantly higher ($p<.01$) than students who did use services. On the other hand, students who used two or more services were significantly more likely to graduate ($p<.05$) than students using just one service. Students who used notetaking services ($n=42$) had significantly higher cumulative GPAs and were more likely to graduate.

There were some differences by gender shown using chi-squared test analysis in Table 3. Males and females did not differ significantly in terms of having a disability or not, but they had proportionately different disabilities: males were five times as likely to have ASD; females were twice as likely to have psychological disabilities, hearing and mobility disabilities. Females were 50% more likely to have learning disabilities, and males were 50% more likely to have ADHD. On the other hand, females consistently used more services than males ($p<.01$). Mother's education level was significantly negatively correlated with students' cumulative GPA ($p=.013$); father's education level was not significantly correlated with students' cumulative GPA. However, gender was not a significant factor relative to number of units per semester or cumulative GPA, except for the first semester in which females had a slighter higher cumulative GPA than males. A binary logistic regression

analysis did not reveal any statistically significance for the variables associated with gender of the students or their parents.

One aspect of finances is EOP (Educational Opportunity Program), which provides supplemental financial assistance to students from low socio-economic backgrounds who are educationally disadvantaged. These recipients tend to be first-generation, minority college students. EOP also provides tutoring, academic advising and training, and peer mentoring. Table 3 shows that only 7% of students with disabilities had EOP status, and their cumulative GPA and graduation rates did not differ significantly from students not in that program (see Table 3). Hispanics constituted 37% and African Americans constituted 24% of the EOP students with disabilities. Hispanics in EOP were more likely to graduate than Hispanics who were not in EOP. However, African Americans in EOP were less likely to graduate than African Americans who were not in the program. The differences between the two ethnic groups' outcomes was significant (p<.05), based on chi square statistical analysis; this finding was not significant when all the variables were accounted for in a logistic regression analysis.

In Table 3 several findings related to majors. Students with disabilities were less likely to major in hard sciences (6% science/math, 6% computer/engineering) and more likely to major in social/behavioral science, across ethnicities. The number of semesters or cumulative GPAs did not differ significantly by major. Graduation rates differed significantly by major: 73% for arts/communication to 52% in computers/engineering and 46% in science/math; only a handful of undeclared graduated. Students with no majors (64%) or majored in hard sciences (science/math 29% and computer/engineering 28%) were most likely to withdraw from the university. Testing accommodations were provided for an average of 44% of students across majors, but significantly less for education majors. Similar findings related to majors were discovered using binary logistic regression analysis (Table 4).

A binary logistic regression (Table 4) revealed several other significant factors that predicted graduation for students with reported disabilities. Students who entered the university more recently were more likely to graduate (4.1% more for each additional year later), the reference year being 2004. Asians were 73.6% more likely than White students to graduate (p< .05). Students with ADHD (the reference disability category) were 121.2% more likely than students with ASD to graduate (p<0.05), 89.3% more likely to graduate than those with hearing impairments (p<.01), and 49.7% more likely than other unclassi-

fied functional limitations (p<.05) to graduate. Students who received financial aid their second to last semester were significantly more likely than those without financial aid, 254.9%, to graduate (p< .01).

## Discussion

The demographic variables, such as ethnicity, gender, and parents' education, had an impact on school outcome for the students with disabilities. For instance, males did not perform as well, which echoes the findings of Pingry O'Neill et al. (2012). Other factors such as major also impacted the success of students with disabilities. Many of the findings reinforce earlier research. The emphasis that follows is on actionable factors such as improving services to support students with disabilities.

Overall, first semester's experience was significant: students with declared majors persisted more than undeclared students, regardless of disability status. Students with disabilities who used supported services targeted to them were more likely to persevere and to perform better, especially if they used services the first semester. For example, for students attending at least two semesters, those with hearing impairments graduated only slightly less than students with other types of disabilities, unlike the first semester outcomes which were significantly worse. This finding reflects the conclusions of Hillier et al. (2018), Hudson (2013), Hodge (2017), and Rause and Lewis (2011), who all emphasized the importance of the first semester in laying out the basis for future academic success. Students with hearing impairments had lower GPAs and interpretative services did not seem to help. Students with ASD were also more at risk. Therefore, these students seem to need more attention than students with other disabilities, which reflected the conclusions of Singley (2018) and Gleckman (1992).

Students in the hard sciences experienced more academic difficulties and were less likely to graduate, as found in the research of Weatherton et al. (2017) and Groah et al. (2017). That situation should be examined more closely to determine the underlying reasons (e.g., remediation courses needed, academic rigor, faculty and student perceptions, social reasons, lack of specific services geared to the major such as use of symbols, etc.); it should be noted, however, that in the general population students in these majors also experienced more academic difficulties than in other majors, so disabilities were not likely to be the distinguishing factor.

Other data revealed more at-risk factors rather than success factors for student enrollment reten-

tion and graduation rate. However, such information is very useful for support services for students with disabilities as it helps services to target their areas of improvement. As noted in the literature review, many studies had limited samplings or narrow foci. The following findings had not been reported in the available literature so they add to the research picture.

- White students were over-represented compared to other ethnicities in terms of having disabilities; this finding should be examined to determine the reason (e.g., awareness of services, issues of stigma, self-advocacy skill, etc.).
- Native American, African American, and Hispanic students did not do as well as White or Asian students. Culturally-responsive instruction could help mitigate the differences.
- EOP seemed to help Hispanics but negatively impacted African Americans in terms of graduating; EOP services and possible culture-sensitivity need investigation.
- Males used fewer services, so might need more encouragement. Males also earned slightly lower grades and were slightly less likely to graduate than females.

### Limitations

The data sets reflected the population of one university, although it is a large and diverse urban institution, so the findings may or may not be generalizable to all kinds of postsecondary institutions such as small liberal arts colleges. The findings were based on the provided data sets, which were only as good as the data entered or calculated. Some of the variables were miscoded when the two data sets were merged, so the original data had to be reviewed and recoded. For a couple of variables dealing with remediation waivers, the existing explanation for coding could not be deciphered, so those variables could not be used for analysis. To minimize data errors, data frequencies were checked before other analyses to see if they were reasonable. For students who indicated that they were two or more races (15% of the population), data were not captured about the composite races.

Additional factors would have also been useful to know, such as the number of students who did not report that they had a disability, but in fact did have disabilities, in order to determine predictive factors for their retention and graduate rate in comparison to students who identified their disability to the campus services for students with disabilities. In addition, other studies examined the impact of coaching, mentoring, and socialization, which were not within the scope of this study. These added factors are usually not captured in institutional data but can be significant in understanding the needs and responsive services for students with disabilities.

### Next Steps and Further Research

The next step will compare the retention and graduation rate of students who did not report having a disability with those students who did indicate a disability. The current data set does have comparable variable values for students without reported disabilities. Then the two populations can be compared to reveal possible differences in retention and graduate rates related to demographic and academic variables.

A further step will consist of using the findings and literature review to identify feasible interventions that management practice can implement to improve student success. To this end, Six Sigma steps will be applied to identify areas for improvement in management practice, and then implement changes to improve such practice to facilitate student success. Six Sigma is a set of management techniques used to improve organizational processes by reducing and controlling process failures or variations.

In terms of further research, other institutions in the same higher education system or other institutions with comparable demographics can be analyzed to determine possible generalizability – or to determine that findings are site-specific. Likewise, community colleges and post-graduate institutions can also be analyzed for possible generalizability or significant differences. Few studies investigate the educational trajectory of students once they leave the institution; additional information about their next steps, such as transferring to a different campus at the same level or different level of education such as a junior college, would be useful data to explore.

Additional factors such as SAT and ACT test results or the number of breaks in enrollment might be significant factors. Follow-up surveys of students who did not graduate might reveal other educational pathways, which might inform staff of services for this population in terms of academic counseling.

The study did not touch upon the social aspects of services, which merits attention. Since several studies mentioned internal factors of self-efficacy and self-advocacy, so continued investigation is needed, especially in terms of the effectiveness of teaching these attitudes and skills to increase students' academic success. Additionally, data could be gathered about complementary applicable services such as writing assistance centers, crisis center counseling, or outside services from public or private agencies.

## Conclusions

Based on the literature review and the data analysis, the researchers identified predictive factors for academic success (GPA and graduation rate) as well as enrollment risk factors for students with reported disabilities. An obvious positive factor is attending more than half time and maintaining a high GPA. Students who continue after the first semester are more likely to graduate. Therefore, services for students with disabilities need to make a concerted effort to publicize their services even before students enroll and make those services easy to find and use the first semester (Hillier et al., 2018; Hodge, 2017; Hudson, 2013; Thurston et al., 2017). Students who declare their majors from the start are also more likely to succeed. Students who used two or more services also fared better, which points to the need for comprehensive and well-coordinated services (Cox et al., 2017; Hong, 2015; Howe, 2013; Seale, 2006).

Several factors were identified as risk factors. In most of these cases, the factor itself cannot be changed, but identifying at-risk students can help target efforts: students with hearing impairments, students with ASD, males, Native Americans, African American, Hispanics. Service effectiveness varied, but students who used registration assistance or interpreter services fared less well than students using other services, indicating that services for students with disabilities need to be monitored to optimize their effectiveness (Kilpatrick et al., 2017).

All students, including students with disabilities, who are admitted into a postsecondary institution constitute an investment by that institution in those individuals' trajectory of success. Therefore, such institutions need to provide a comprehensive and cohesive system of services based on students' needs. To that end, that system of services needs to collect, analyze and act upon a rich collection of a wide range of data points. This system requires university-side support of human, material and fiscal resources (Seale, 2006). The human return on the investment is worth it.

## References

Braun, D. C., Gormally, C., & Clark, M. D. (2017). The deaf mentoring survey: A community cultural wealth framework for measuring mentoring effectiveness with underrepresented students. *CBE - Life Sciences Education, 16*, 1-11.

Bueno, S. A. (2017). *The role of relationships with institutional agents in the academic trajectory of first-generation college students with disabilities: A grounded theory study.* [Doctoral dissertation] .Retrieved from ProQuest Dissertations and Theses database. (UMI No. 10042220)

Cox, B., Thompson, K., Anderson, A., Mintz, A., Locks, T., Morgan, L., Edelstein, J., & Wolz, A. (2017). College experiences for students with Autism Spectrum Disorder: Personal identity, public disclosure, and institutional support. *Journal of College Student Development, 58*, 71-87.

Cullen, J. A. (2015). The needs of college students with Autism Spectrum Disorders and Asperger's Syndrome. *Journal of Postsecondary Education and Disability, 28*, 89-101.

Davidson, W., Beck, H., & Milligan, M. (2009). The College Persistence Questionnaire: Development and validation of an instrument that predicts student attrition. *Journal of College Student Development, 50*, 373-390.

Gleckman, A. (1992). *A psychological profile of the learning-disabled college student.* [Doctoral dissertation]. Retrieved from ProQuest Dissertations and Theses database. (UMI No. 9236377)

Groah, C. H., Evans Getzel, E., Rachel, C., Graham, C. W., Russell, C., & Walker, A. (2017). Perceptions of GI Bill recipients with disabilities of science, technology, engineering, and math (STEM) as a viable career choice. *Journal of Vocational Rehabilitation, 47*, 109-117.

Hillier, A., Goldstein, J., Murphy, D., Trietsch, R., Keeves, J., Mendes, E., & Queenan, A. (2018). Supporting university students with Autism Spectrum Disorder. *Autism: The International Journal of Research & Practice, 22*, 20-28.

Hinz, S., Arbeit, C., & Bentz, A. (2017). *Characteristics and outcomes of undergraduates with disabilities.* Washington, DC: National Center for Education Statistics.

Hodge, D. (2017). *The effectiveness of the student support service program on retention at a rural Appalachia Community College.* [Doctoral dissertation]. Retrieved from ProQuest Dissertations and Theses database. (UMI No. 10268849)

Hong, B. S. (2015). Qualitative analysis of the barriers college students with disabilities experience in higher education. *Journal of College Student Development, 56*, 209-226.

Howe, S. M. (2013). *Academic accommodations, social supports, and academic self-efficacy: Predictors of academic success for postsecondary students with disabilities.* [Doctoral dissertation]. Retrieved from ProQuest Dissertations and Theses database. (UMI No. 3605997)

Hudson, R. L. (2013). *The effect of disability disclosure on the graduation rates of college students with disabilities.* [Doctoral dissertation]. Retrieved from ProQuest Dissertations and Theses database. (UMI No. 10668520)

Jorgensen, M., Budd, J., Fichten, C. S., Nguyen, M. N., & Havel, A. (2018). Graduation prospects of college students with specific learning disorder and students with mental health related disabilities. *International Journal of Higher Education, 7*, 19-31.

Joshi, G., & Bouck, E. (2017). Examining postsecondary education predictors and participation for students with learning disabilities. *Journal of learning disabilities, 50*, 3-13.

Kilpatrick, S., Johns, S., Barnes, R., Fischer, S., McLennan, D., & Magnussen, K. (2017). Exploring the retention and success of students with disability in Australian higher education. *International Journal of Inclusive Education, 21*, 747-762.

King, J. (2014). *Retention of undergraduate students with disabilities at the University of Washington.* [Doctoral dissertation]. Retrieved from ProQuest Dissertations and Theses database. (UMI No. 3631871)

Koehler, J. (2013). *Predictors of postsecondary education attendance for youth with learning disabilities.* [Doctoral dissertation, Syracuse University].

McGinty, J. (2017). *Accessibility and inclusion in higher education: An inquiry of faculty perceptions and experiences*. [Doctoral dissertation]. Retrieved from ProQuest Dissertations and Theses database. (UMI No. 10149928)

McGregor, K., Langenfeld, N., Van Horne, S., Oleson, J., Anson, M., & Jacobson, W. (2016). The university experiences of students with learning disabilities. *Learning Disabilities, 31,* 90-102.

Moriña, A., López-Gavira, R., & Morgado, B. (2017). How do Spanish disability support offices contribute to inclusive education in the university? *Disability & Society, 32*, 1608-1626.

Pingry O'Neill, L., Markward, M., & French, J. (2012). Predictors of graduation among college students with disabilities. *Journal of Postsecondary Education and Disability, 25*, 21–36.

Raue, K., & Lewis, L. (2011). *Students with disabilities at degree-granting postsecondary institutions*. Washington, DC: National Center for Education Statistics.

Seale, J. (2006). *E-learning and disability in higher education: Accessibility research and practice.* New York, NY: Routledge.

Shapiro, D., Dundar, A., Wakhungu, P., Yuan, X., Nathan, A., & Hwang, Y. (2017). *Completing college: A national view of student completion rates – fall 2011 cohor*t. Herdon, VA: National Students Clearinghouse Research Center.

Siew, C., Mazzucchelli, T., Rooney, R., & Girdler, S. (2017). A specialist peer mentoring program for university students on the Autism spectrum: A pilot study. *Plos ONE, 12*(7), 1-18.

Singley, D. (2018). *Effects of academic coaching on college students with learning disabilities or attention-deficit hyperactivity disorder.* [Doctoral dissertation]. Retrieved from ProQuest Dissertations and Theses database. (UMI No. 10278516)

Thompson-Ebanks, V. (2012). *Experiences of students with disabilities: Factors that influence their withdrawal as baccalaureate degree seeking students.* [Doctoral dissertation]. Retrieved from ProQuest Dissertations and Theses database. (UMI No. 3523823)

Thurston, L., Shuman, C., Middendorf, B., & Johnson, C. (2017). Postsecondary STEM education for students with disabilities: Lessons learned from a decade of NSF funding. *Journal of Postsecondary Education and Disability, 30*, 49-60.

Waale, M. (2017). Supporting differently-abled students in two New Jersey community colleges. [Doctoral dissertation]. Retrieved from ProQuest Dissertations and Theses data¬base. (UMI No. 10585051

Weatherton, Y., Mayes, R., & Villanueva-Perez, C. (2017). *Barriers to persistence for engineering students with disabilities. In Proceedings of The ASEE Annual Conference & Exposition* (pp. 3243-3254). Washington, DC: American Society for Engineering Education.

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**Table 1**

*Leading Disabilities and Associated Services*

| | Disability Service Used | | | |
| --- | --- | --- | --- | --- |
| Type of Disability | Registration Help (%) | Testing Help (%) | Interpretation (%) | More than One Disability Services Used (%) |
| Learning (*n*=649, 25%) | **49** | 33 | 0 | 17 |
| ADHD (*n*=541, 21%) | 34 | **61** | 0 | 1 |
| Hearing (*n*=342, 13%) | 0 | 0 | **99** | 0 |
| Psychological (*n*=331, 13%) | 21 | **72** | 0 | <1 |
| Mobility (*n*=252, 10%) | **41** | 37 | 0 | 15 |

*Note.* Boldfaced numbers indicate the type of service most often used.

**Table 2**

*Students with Disabilities by Ethnicity*

| Ethnicity | Disability Type | | | | | | |
|---|---|---|---|---|---|---|---|
| | ADHD (%) | Autism Spectrum Disorder (%) | Learning Disability (%) | Hearing (%) | Visual (%) | Psycho-logical (%) | Mobility (%) |
| White (*n=*1,326, 51% of students with disabilities, 23% of total student body) | 7 | 3 | 23 | 13 | 3 | 12 | 9 |
| Hispanic (*n=*507, 20%, 46%) | 14 | 2 | 30 | 14 | 4 | 18 | 9 |
| Mixed race ethnicity (*n=*378, 14%, 17%) | 23 | 2 | 28 | 7 | 4 | 14 | 13 |
| Asian (*n=*170, 7%, 11% ) | 26 | 4 | 9 | 32 | 4 | 17 | 9 |
| African American (*n=*172, 7%, 5%) | 12 | 2 | 36 | 3 | 3 | 15 | 12 |
| Native American or Pacific Islander (*n=*25, 1%, 1%) | 32 | 0 | 28 | 4 | 8 | 16 | 8 |

**Table 3**

*Final GPA and Graduation Rate of Students with Disabilities According to Various Variables*

| | Sample Size (total *n*=2,578) | % of Students with Disabilities | Cumulative Final GPA (std. deviation) | % within this Group that Graduated (62.8% overall students with disabilities who graduated) | X² (*p*: see note) |
|---|---|---|---|---|---|
| **Gender** | | | | | 1.48 (NS) |
| Female | 1,337 | 56.1 | 2.84 (0.94) | 63.8 | |
| Male | 1,131 | 43.9 | 2.67 (0.92) | 61.5 | |
| **Father's Education** | | | | | 18.87 (*p<0.05*) |
| ≤ High School Diploma | 763 | 29.6 | 2.76 (0.92) | 63.8 | |
| Some College | 542 | 21.0 | 2.82 (0.82) | 64.4 | |
| 2-Year Degree | 495 | 19.2 | 2.75 (0.96) | 65.5 | |
| Bachelor's Degree | 410 | 15.9 | 2.74 (0.97) | 64.4 | |
| Post-Graduate | 368 | 14.3 | 2.71 (1.00) | 52.7 | |
| **Mother's Education** | | | | | 26.65 (*p=0.05*) |
| ≤ High School Diploma | 759 | 29.4 | 2.81 (0.87) | 63.8 | |
| Some College | 629 | 24.4 | 2.86 (0.80) | 68.5 | |
| 2-Year Degree | 505 | 19.6 | 2.65 (1.03) | 63.8 | |
| Bachelor's Degree | 366 | 14.2 | 2.69 (1.04) | 58.2 | |
| Post-Graduate | 319 | 12.4 | 2.75 (0.99) | 52.7 | |
| **Department** | | | | | 222.46 (*p<0.05*) |
| Arts, Media, Communication | 371 | 14.4 | 2.85 (0.79) | 73.0 | |
| Business | 311 | 12.1 | 2.75 (0.75) | 63.7 | |
| Computers, Engineering | 151 | 5.9 | 2.61 (0.94) | 52.3 | |
| Education | 237 | 9.2 | 3.06 (0.91) | 65.0 | |
| Health & Human Services | 350 | 13.6 | 2.76 (1.01) | 67.1 | |
| Liberal Studies | 291 | 11.3 | 2.81 (0.74) | 67.0 | |
| Science, Math | 156 | 6.1 | 2.58 (1.07) | 47.4 | |
| Social Sciences | 598 | 23.2 | 2.92 (0.79) | 68.2 | |
| Undeclared | 113 | 4.4 | 1.44 (1.30) | 3.5 | |
| **EOP Status** | | | | | 0.01 (NS) |
| No | 2,408 | 93.4 | 2.77 (0.94) | 62.7 | |
| Yes | 170 | 6.6 | 2.71 (0.79) | 62.9 | |

| | Sample Size (total *n*=2,578) | % of Students with Disabilities | Cumulative Final GPA (std. deviation) | % within this Group that Graduated (62.8% overall students with disabilities who graduated) | X² (*p*: see note) |
|---|---|---|---|---|---|
| **Veteran** | | | | | 0.51 (NS) |
| No | 2,540 | 98.6 | 2.77 (0.95) | 62.3 | |
| Yes | 36 | 1.4 | 2.80 (0.85) | 66.7 | |
| **Disability Types** | | | | | 76.53 (*p*<0.05) |
| ADHD | 541 | 21.0 | 2.68 (0.86) | 66.2 | |
| ASD | 65 | 2.5 | 2.37 (1.15) | 43.1 | |
| Deaf | 336 | 13.0 | 2.31 (1.32) | 45.8 | |
| Learning Disability | 638 | 24.7 | 2.77 (0.82) | 62.5 | |
| Mobility Limitation | 246 | 9.5 | 3.02 (0.79) | 72.8 | |
| Other Functional Limitations | 253 | 9.8 | 2.93 (0.86) | 61.7 | |
| Psychological | 327 | 12.7 | 2.99 (0.69) | 61.7 | |
| Visual Limitation | 78 | 3.0 | 2.90 (0.94) | 65.4 | |
| 2 or More Disabilities | 92 | 3.6 | 3.01 (0.75) | 76.6 | |
| **Disability Services Used** | | | | | 80.43 (*p*<0.05) |
| Disability Related Counseling | 59 | 2.3 | 2.90 (0.82) | 66.1 | |
| Interpreter | 334 | 13.0 | 2.31 (1.32) | 45.8 | |
| Registration Assistance | 747 | 29.0 | 2.71 (0.96) | 45.8 | |
| Test Taking Accommodations | 1,145 | 44.4 | 2.86 (0.76) | 68.3 | |
| 2 or More Services | 249 | 9.7 | 2.99 (0.67) | 72.3 | |
| None | 44 | 1.7 | 3.02 (0.67) | 79.5 | |
| **Number of Services** | | | | | 16.91 (*p*=.05) |
| 0 | 44 | 1.7 | 3.02 (0.67) | 79.5 | |
| 1 | 2,285 | 88.6 | 2.73 (0.95) | 61.4 | |
| 2 | 236 | 9.2 | 2.99 (0.77) | 72.0 | |
| 3 | 13 | 0.5 | 2.96 (0.63) | 76.9 | |
| **Number of Semesters in School** | | | | | 337.864 (*p*<.05) |
| 1 Semester Only | 186 | 7.2 | 1.18 (1.51) | -- | |
| 2 or More Semesters | 2,392 | 92.8 | 2.89 (0.74) | 67.6 | |
| **Number of Units Enrolled Last Term** | | | | | 680.927 (*p*<.05) |
| <7 | 1,228 | 47.6 | 2.41 (1.18) | 36.7 | |
| 7-11 | 333 | 12.9 | 3.11 (0.45) | 85.9 | |
| 12-15 | 817 | 31.7 | 3.07 (0.42) | 87.3 | |
| >15 | 200 | 7.8 | 3.08 (0.43) | 84.0 | |

| | Sample Size (total n=2,578) | % of Students with Disabilities | Cumulative Final GPA (std. deviation) | % within this Group that Graduated (62.8% overall students with disabilities who graduated) | X² (p: see note) |
|---|---|---|---|---|---|
| **Ethnicity** | | | | | 12.72 (p=0.025) |
| Native American | 25 | 1.0 | 2.42 (1.29) | 40.0 | |
| Asian | 170 | 6.6 | 2.60 (0.96) | 66.5 | |
| African American | 172 | 6.7 | 2.55 (0.78) | 58.7 | |
| Hispanic | 507 | 19.7 | 2.71 (0.90) | 60.6 | |
| White | 1,326 | 51.4 | 2.82 (0.94) | 62.7 | |
| 2 or More | 378 | 14.7 | 2.83 (0.94) | 67.7 | |

*Note.*  p is an adjusted p-value controlling for multiple comparisons; NS = not significant; ASD = autistic spectrum disorder; ADHD = attention deficit hyperactivity disorder; EOP = educational opportunity program.

**Table 4**

*Variables in the Binary Logistic Regression Equation*

|  | Significance | Odds Ratio | 95% C.I. for Odds (Lower, Upper) |
|---|---|---|---|
| **Admit Term** | .048* | 1.041 | (1.000, 1.083) |
| **Number of Semesters** | .000** | 1.188 | (1.150, 1.227) |
| **Number of Units Enrolled Last Term** (ref is <7) | | | |
| 7-11 | .00** | 6.304 | (4.384, 9.063) |
| 12-15 | .000** | 8.168 | (6.187, 10.781) |
| More than 15 | .000** | 6.629 | (4.281, 10.265) |
| **Father's Education** (ref is some college) | | | |
| High School or less | .689 | 1.067 | (.778,1.461) |
| College degree | .128 | 1.286 | (.930, 1.780) |
| Postgrad degree | .364 | 1.179 | (.827, 1.680) |
| Unknown | .354 | 0.731 | (.377, 1.418) |
| **Mother's Education** (ref is some college) | | | |
| High School or less | .424 | 0.883 | (.651, 1.198) |
| College degree | .953 | 0.991 | (.721, 1.361) |
| Postgrad degree | .135 | 0.762 | (.533, 1.088) |
| Unknown | .318 | 0.703 | (.353, 1.403) |
| **Gender** male compared to female | .439 | 1.087 | (.879, 1.345) |
| **Cumulative GPA** last term | .000** | 2.186 | (1.892, 2.525) |
| **EOP Status** (has EOP) | .635 | 1.114 | (.712, 1.744) |
| **Department** (ref is Arts/Media/Communication) | | | |
| Business | .051 | 0.683 | (.466, 1.001) |
| Computer Science/Engineering | .00** | 0.416 | (.260, .666) |
| Education | .013* | 0.584 | (.381, .893) |
| Health/Human Services | .178 | 0.768 | (.523, 1.127) |
| Liberal Arts | .193 | 0.773 | (.524, 1.139) |
| Science/Math | .000** | 0.282 | (.175, .453) |
| Social Studies | .142 | 0.777 | (.554, 1.089) |
| Undeclared | .000** | 0.023 | (.007, .079) |
| **Disability Type** (ref is ADHD) | | | |
| ASD | .015* | 0.452 | (.239, .855) |
| Deaf | .001** | 0.528 | (.364, .768) |
| Learning Disability | .612 | 0.924 | (.682, 1.252) |
| Mobility Limitation | .459 | 1.163 | (.780. 1.734) |
| Other Functional Limitation | .039* | 0.668 | (.455, .980) |
| Psychological | .252 | 0.815 | (.574, 1.157) |

| | | | |
|---|---|---|---|
| Visual Limitation | .384 | 0.768 | (.423, 1.392) |
| Two or more disabilities | .282 | 1.406 | (.756, 2.612) |
| Total services | .787 | 0.957 | (.694, 1.318) |
| **Financial Aid 2nd to last** | .000* | 3.549 | (2.619, 4.807) |
| **Ethnic Group** (ref is white) | | | |
| Native American Only | .052 | 0.398 | (.157, 1.009) |
| Asian Only | .013* | 1.736 | (1.125, 2.680) |
| African American Only | .559 | 1.135 | (.742, 1.735) |
| Hispanic Only | .427 | 0.893 | (.677, 1.180) |
| Mixed Races | .120 | 1.272 | (.939, 1.721) |
| **Constant** | .044* | 0.000 | |

*Note. * p<.05; ** p<.01; C.I. = Confidence Interval.*

**Figure 1**

*Number of Students with Disabilities by Type of Disability, From 2004 to 2013*
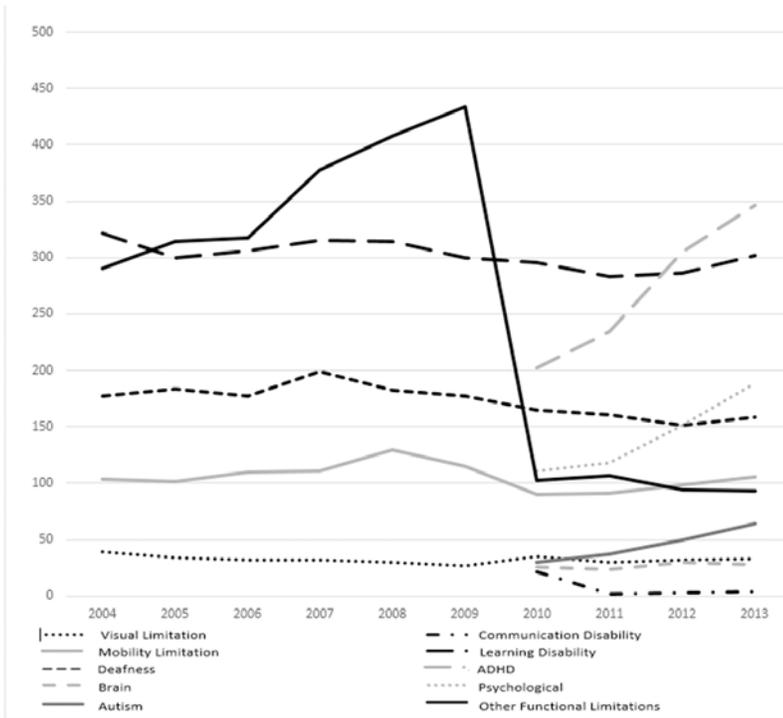


**Figure 2**

*Disabilities Services Used by Proportion of Students between 2004-2013*