Predictors of Graduation Among College Students with Disabilities

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Abstract

This exploratory study determined which set of student characteristics and disability-related services explained graduation success among college students with disabilities. The archived records of 1,289 unidentified students with disabilities in three public universities were examined ex-post-facto to collect demographic data on the students, the disability-related services they qualified for while enrolled in the institution, and student graduation status. A hierarchical logistic regression framework was used to compare models predicting graduation among students with disabilities in college. A model selection procedure was then used to construct a parsimonious model of the data. The final model constructed included predictors related to gender, age, disability type, and several disability-related services. Given the limitations of this study, more research is needed to validate this model using a similar sample of students with disabilities in 2-year and 4-year institutions.

Keywords: Postsecondary education, disabilities, accommodations, graduation, college students

Many persons with disabilities have difficulty obtaining competitive employment due to lack of education and inadequate supports, which often means these individuals are unable to financially support themselves and live above the poverty line. In order to be competitive in the current labor market, it has become increasingly important for individuals with disabilities to receive a college degree (Gil, 2007), primarily because having a four-year degree is positively correlated with employment rates (Stodden, Dowrick, Anderson, Heyer, & Acosta, 2005). With these trends in mind, universities can best support students with disabilities by ensuring that they receive the appropriate accommodations needed to move towards successful completion of courses and graduation.

Conceptual Framework

Astin (1998) identified the input-environment-output college impact model (IEO) in which the major proposition is that the characteristics and abilities students bring to the college experience and environmental factors within the postsecondary academic setting significantly impact their ability to succeed. While student characteristics include demographics, skills, experiences, motivation, academic achievements, and aptitude test scores (Astin, 1998), environmental factors that influence student success include administrative policies, curriculum, student services, teaching practices, peers, and technology. In this context, it seems salient to identify which combination of individual and environmental factors best predict graduation outcomes of students with disabilities (Astin, 1998).

Background/Rationale

Although enrollment of students with disabilities in higher education has decreased slightly in recent years, their overall pattern of enrollment has significantly increased in the United States since the 1960s (Dukes, 2001). With this increase, universities have created more accessible facilities and worked toward ensuring that students receive the appropriate accommodations they need to have equal access to postsecondary environments. In the academic year 2007-2008, more females (57.3%) than males were

enrolled in postsecondary institutions at the undergraduate level (National Center for Education Statistics [NCES], 2010). Although two thirds of undergraduate students with disabilities were white, the remaining third were Black (12.7%), Hispanic (12.3%), Asian/Pacific Islander (4.8%), American Indian/Alaska Native (0.8%), and "other" (3.2%). More than half of the students were between 15 and 23 years of age (54%), 20.1% of students were between 24 and 29 years of age, and 25.9% of students between 30 years of age and older. Between 2003-2004 and 2007-2008, there was a 12.1% percentage decrease in the undergraduate enrollment among students 30 years of age and older, but there was a similar percentage increase in enrollment among younger students between 15 and 29 years of age (NCES, 2010).

Horn and Nevill (2006) found that 11% of undergraduate students reported a disability, the majority of whom attended four-year public institutions. In the 2003-2004 school year students reported the following disabilities: orthopedic (25.4%), mental illness/depression (21.9%), health impairment (17.3%), attention deficit disorder ([ADHD], 11%), learning disability ([LD], 07.5%), hearing impairment (5.0%), visual impairment (3.8%), speech impairment (0.4%), and other (7.8%). Females were more likely than males to report mental and physical health problems, while men were more likely to report ADHD.

In 2007-2008, 60.8% of students with disabilities enrolled at the graduate level were female (NCES, 2010). Nearly 64% of graduate students were white, which is similar to the percentage of white students enrolled at the undergraduate level. While the proportion of Black and Asian/Pacific Islander students enrolled at the graduate level (19%, 7.3%) was greater than at the undergraduate level (12.7%, 4.8%), the proportion of Hispanic students enrolled at the graduate level (7.4%) was lower than at the undergraduate level (12.3%). As one might expect, there are greater numbers of students with disabilities who are 24 years of age and older enrolled at the graduate level (92.2%) than at the undergraduate level (46%).

Barriers to Academic Success

Students with disabilities encounter more academic, attitudinal, and physical barriers while attending college than students without disabilities. Specifically, they are more likely than their non-disabled peers to have difficulty in the following areas: study/test skills, note-taking, listening comprehension, organization, social skills, self-esteem, and reading/writing deficits (Reaser, Prevatt, Petscher, & Proctor, 2007; Trainin & Swanson, 2005). Students also have concerns about the ability of instructors to modify classroom environments to meet their needs. Junco (2002) found that negative instructor attitudes decreased the willingness of students to advocate for themselves. In this regard, students with physical disabilities, especially those who use wheelchairs, have considerable difficulty negotiating many campus environments.

Disability-Related Services Needed

In terms of services needed, Getzel, McManus, and Briel (2004) assessed the effectiveness of the supported model of postsecondary disability services and found that students value time management strategies, use of technology, self-advocacy strategies, study/test taking support, and practice sessions that help students achieve clinical requirements. In particular, effective self-advocacy, as well as self-determination, results in success for college students with disabilities (Getzel & Thoma, 2008; Gil, 2007; Skinner, 2004). In terms of technology, one group of students in Canada valued spelling/grammar aid, dictation software, scanners, portable note-taking devices, and materials presented in electronic format (Fichten, Asuncion, Barile, Fossey, & Robillard, 2001; Fichten et al., 2004).

Disability-related Services and Academic Success

In one study, computer laboratory utilization and less advisement contributed positively to cumulative grade point average (GPA) of students with disabilities (Keim, McWhirter, & Bernstein, 1996). In another study, course substitutions, particularly substitutions for foreign language requirements, contributed positively to the graduation rates of students with disabilities (Skinner, 1999). Test accommodations, specifically giving students extra time to take exams, positively influenced the test scores of students with learning disabilities (Jarvis, 1996; Ofiesh, 2000; Runyan, 1991a, 1991b; Weaver, 2000). In examining outcomes of students with learning disabilities in a Canadian college over a 12-year period, Jorgensen et al. (2005) found that those who took lighter course loads earned the same grades and had the same graduation outcomes as students without disabilities.

Impact Models to Measure Academic Success

Numerous enactments have been passed to enhance the lives of persons with disabilities. Those include the Architectural Barriers Act of 1968 (P.L. 93-480), Rehabilitation Act of 1973 (P.L. 93-112), Education for All Handicapped Children Act of 1975 (P. L. 94-142), which is now the Individuals with Disabilities Education Act (IDEA, P.L. 105-17) with 1990, 1997, and 2004 amendments, Fair Housing Act (P.L. 100-430), and the Americans with Disabilities Act (P.L. 101-336) with 2008 amendments. Despite the importance of these enactments, nearly one-fourth of college students with disabilities reported not receiving the appropriate accommodations needed to be academically successful (NCES, 2003). Even though the Americans with Disabilities Act provides a legal avenue for individuals with disabilities to pursue if their civil rights are not granted due to discrimination on the basis of disability (Eckes & Ochoa, 2005), differences in interpretation of the act make it difficult to address those practices legally (Tagayuna, Stodden, Chang, Zeleznik & Whelley, 2005).

Even so, legal recourse may be unnecessary, given that experts in higher education now acknowledge that environmental factors impact student success in college as much as the student's disability, if not more (Burgstahler, 2007; Whelley, Hart, & Zafft, 2002). As a result, universities are considering the use of impact models to assess the progress of students with disabilities (Pascarella & Terensini, 2005). Unfortunately, there is no model of variables that shows which combination of student characteristics and environmental services predicts graduation among college students with disabilities.

Purpose of Study

Using both individual characteristics and disability-related services identified in the literature as potential predictors of graduation among students with disability, this study identified a relatively small combination of student characteristics and services that provided nearly optimal prediction ability of graduation among college students with disabilities. The following research questions were answered:

1. What are the individual characteristics of students registered in the disability offices of public, four-year universities, and how do they vary by primary disability of students?
2. What types of services do students qualify for through the disability offices of the universities, and how do services vary by primary disability of students?
3. What is the graduation rate of students registered at disability offices at public, four-year universities, and how does it vary by primary disability of students?
4. Which set of student characteristics and disability-related services are useful in predicting graduation among college students with disabilities?

Method

Participants

This study surveyed students qualifying for postsecondary disability services *ex post facto* via information contained in the records of students qualifying for accommodations by registering for services in university disability offices. A non-probability purposive sample of 1,289 inactive files of former students located in the disability offices of three Midwestern public universities was identified for the record review. The three universities will be identified in this article as universities A, B, and C. Student records from disability offices included all student files deemed inactive in the school years 2001-2002 through 2004-2005.

Only records of students who were no longer enrolled at the universities were reviewed. Each university's institutional review board waived the informed consent of the students for the following reasons: data were analyzed in aggregate and no names were attached in any way, ensuring anonymity when data were transferred from records onto the questionnaire. The resulting raw data were kept in a locked file cabinet located in the office of the researchers.

Materials

A 20-item questionnaire was developed to be used as a mechanism to collect student demographic data, qualified disability-related services, and student graduation. Demographic variables included gender, age, ethnicity, disability, and student status (undergraduate/graduate). Students' disabilities were categorized into three primary types: (a) cognitive, (b) mental disorder, and (c) physical. Accommodation variables included: (a) accessible classrooms, (b) alternative format tests and assignments, (c) assistive technology, (d) class-

room assistants, (e) course waivers or substitutions, (f) distraction reduced testing, (g) extended test time, (h) flexibility in assignment and test dates, (i) interpreting services, (j) learning strategies/study skills assistance, (k) note taking services, (l) physical therapy/ functional training,(m) residence halls specialized in accommodating students with physical disabilities, (n) support groups/ individual counseling, and (o) transportation. The outcome variable was student graduation status.

Procedure

The study utilized a prediction survey design that relied upon information contained in the records of college students with disabilities. The record review was used as a mechanism to collect student demographic data, qualified disability-related services, and student graduation status. In the process, no subjects were directly involved. This design was selected because it allowed the researchers to determine which set of student characteristics and disability-related services are most highly related to students' graduation rate.

The University of Missouri's Campus Institutional Review Board (IRB), as well as those of the three universities that participated in this research, approved the study and waived informed consent due to anonymity. The researchers asked administrators of the disability support programs at all three participating institutions by telephone if they would participate in the study. Administrators were informed of the criteria for selecting student case files that were deemed inactive from the school years 2001-2002 through 2004-2005. During this time period, 206 (University A), 345 (University B), and 738 (University C) inactive student files in the three universities served as the sample from which data were collected. After the IRB officials at the participating universities signed forms to approve the study, the researchers, with the help of a graduate student worker, proceeded to systematically collect the data from student files. Student name was not linked to records; instead, each questionnaire was numbered and data from records were transferred to the questionnaire.

Variables. The design of this study utilized 19 predictor variables and a single outcome variable, college graduation. The predictor variables included gender, age, ethnicity, disability, student status (undergraduate/ graduate) and accommodation services provided. Students' disabilities were categorized into three primary types; (a) cognitive, (b) mental, or (c) physical disorder. The three types of disabilities require professional validation via documentation and/or assessment. The following definitions were used to categorize student disability in this study.

Disability categories. First, students with cognitive disabilities included those with a specific learning disability, attention deficit hyperactivity disorder (ADHD), or a traumatic brain injury/ acquired brain injury. Second, students with mental disorders must provide current documentation from a licensed professional that includes a specific, current psychiatric diagnosis as per the DSM-IV. Examples included depression, anxiety disorders, bipolar disorder, and schizophrenia. Third, students with physical disabilities included students with deafness or hearing loss, students with a visual impairment or who are blind, and students with a mobility, systemic, or disease-related disability such as spinal cord injury, amputations, cerebral palsy, arthritis, diabetes, heart/lung conditions, kidney disease and cancer. Only the students' primary disability was documented during the record review, which was defined by the universities as the disabling condition that has the greatest impairing effect on academic progress and performance. Not all of the participating disability offices in this study documented students' secondary disability; therefore, this variable could not be included in the analysis.

Disability-related services. Fifteen disability-related services identified in the literature as potential predictors of graduation among students with disability, and listed by at least one of the participating disability offices as a service provided by their center, were included on the questionnaire. All universities provided students with accessible classrooms, alternative format tests/assignments, assistive technology, classroom assistants, extended test time, interpreter services, and note-taking services. Universities B and C provided students with distraction-reduced testing, course waiver/substitutions, and flexibility in assignments/ test dates. Learning strategies/study skills assistance, physical therapy, specialized residence hall, group/ individual counseling, and transportation at no cost were services provided by the disability office at university C. It is also important to note that priority/ early registration was not included as an accommodation variable because not all of the participating disability offices maintained records on this service. This was due to the fact that the service is provided by the registration office at the universities.

The researchers compared and reviewed disability-related service descriptions provided by the participating universities to ensure similar services were provided at each university. They then used the descriptions of each accommodation across disability offices to develop definitions that were used during the record review to ensure each accommodation was being documented in the same way.

Academic accommodations include: (a) accessible classrooms, allowing for student physical accessibility; including preferential/ accessible seating, lap boards, table top desks, class relocation, frequent breaks, and permission to stand or lay down during class; (b) alternative format tests or assignments, providing students with the option to request the format of a test or assignment be altered, such as altering a multiple-choice exam to essay format; (c) assistive technology, providing resources such as sound amplification systems, adaptive computers, talking calculators, voice synthesizers, tape recorders, calculators or keyboards with large buttons, and text conversion in an alternative format; (d) classroom assistants, who may be a scribe, reader, lab assistant, library assistant, or mobility assistant; (e) course waivers or course substitutions, allowing students to have a foreign language, communication, or quantitative reasoning requirement waived or substituted for another course; (f) distraction-reduced testing, allowing a student to test in a room having fewer sensory distractions; (g) extended test time granting a student additional time for completing tests (ranging from time and a half to unlimited time); (h) flexibility in assignment and test dates to address disabilities that fluctuate, such as depression or diabetes; (i) interpreter services, providing interpreters to students in the classroom who have a documented profound hearing loss or deafness; (j) learning strategies and study skills assistance, granting one-on-one weekly, biweekly, or as-needed appointments with a learning disabilities specialist to work on learning strategies, such as test preparation, reading comprehension, written expression, organization, goal setting, and problem solving; and (k) note taker services, providing students with lecture notes.

Non-academic disability-related services include: (l) physical therapy and functional training, aiding students whose disabilities significantly limit the effective utilization of university fitness and recreational resources in implementing personal exercise programs, particularly for developing and maintaining range of motion, strength, conditioning, and transfer skills; (m) specialized residence halls, accommodating the residential needs of students with severe physical disabilities by assisting students in the development of a transitional disability management plan and empowering students to share in the responsibility for managing personal attendant staff with the residential administrative team; (n) support groups and individual counseling, addressing the needs of students with ADHD, learning disabilities, physical disabilities, and students with mental disorders; and last (o) transportation services, providing accessible university transportation to students with disabilities through the university disability office.

Data collection. The researchers traveled to universities A and B to collect data directly from student files located within the disability offices. Disability office personnel at each university escorted the researchers to file drawers that contained student files deemed inactive from the school years 2001-2002 through 2004-2005. The researchers reviewed student demographic information and disability accommodations documented in individual files and recorded this information onto the 20-item questionnaire. Application of disability and accommodation descriptions developed for the study was regularly reviewed during this process to ensure predictor variables were documented in the appropriate category. Each student's school identification number was then documented on the 20-item questionnaire. Once student demographic and accommodation information was collected, all student identification numbers were entered into the campus-wide database to determine student graduation status, which was then recorded on individual questionnaires as a binary (yes/no) variable. Since it is unknown whether students who withdrew from their university before graduating transferred to another postsecondary institution to complete their degree, any student who did not graduate before leaving the university was classified as "no" for graduation status.

A graduate student employed in the disability support center at university C was recruited and trained to collect the required information from the student database in the center. The researchers briefed the graduate student worker on the research project, reviewed the 20-item questionnaire, and provided written definitions of the disability categories and accommodation descriptions. The researchers then discussed the categories with the student worker and checked for

understanding. Additionally, the researchers were in regular communication with the graduate assistant to answer questions related to the assigned disability and accommodation categories. University C's disability center database was connected to the campus-wide database allowing the graduate student to access graduation status for each student.

Scoring and data analysis. The record review survey was used as a mechanism to collect student demographic data, qualified disability-related services, and student graduation. Student demographics were recorded on the questionnaire as categorical variables of the appropriate measurement level. The disability-related services each student qualified for were recorded as binary, categorical variables (yes/no), as was student graduation status. Once data collection was completed at all three universities, the researchers converted all data into an SPSS dataset.

Binary logistic regression was used to construct a model relating student characteristics and disability-related services to graduation status, with a goal of finding the variables which helped to accurately predict graduation. Binary logistic regression analysis differs from multiple linear regression analysis in that the outcome variable of interest is a binary categorical variable (in this case, graduated or did not graduate) as opposed to a numerical variable. Consequently, the standard assumptions of multiple linear regression analysis are violated and multiple linear regression is not an appropriate technique to analyze the data.

Binary logistic regression models the probability an outcome occurs using a non-linear function of the predictor variables. The resulting equation can be used to predict whether the outcome of interest occurs for a specific subject using the observed values of the predictor variables. In this study, the probability that a student graduated was modeled using the demographic and disability services data gathered in the questionnaires. One may refer to Hosmer and Lemeshow (2000) or Mertler and Vennatta (2005) for more details about binary logistic regression analysis.

The effect size of a specific variable in logistic regression is often quantified through the use of the odds ratio. All of the predictor variables considered in this study are binary, indicating whether a student possessed a particular characteristic. Consequently, the odds ratio for a predictor variable in this context is the odds a student graduates when the characteristic is present, divided by the odds a student graduates when the characteristic is not present (Hosmer & Lemeshow, 2000). More specifically, if the odds ratio for a predictor variable is more than 1, then a student is more likely to graduate if he/she possesses that characteristic. If the odds ratio for a predictor variable is less than 1, then a student is more likely to graduate if that attribute is not present. An odds ratio of 1 for a predictor variable indicates that the variable does not appear to affect the probability a person graduates.

One may assess the adequacy of the fit of a binary logistic regression model in a number of ways. One of the most common measurements of the fit of the model is the -2 Log Likelihood value. Informally, this statistic measures how likely it is that the data came from the proposed model. The smaller the value, the more likely it is that the data came from the proposed model, indicating a better model fit (George & Mallery, 2000). An alternative measure of model fit is Akaike's Information Criterion (AIC) statistic (Akaike, 1974). This criterion is based on the -2 Log Likelihood but penalizes for every variable added to the model so that too many predictor variables are not added to the model. As with the -2 Log Likelihood value, the smaller the AIC statistic, the better the model explains the data. The AIC statistic provides the researcher with an objective method for model selection.

Results

Student Characteristics

The researcher reviewed the inactive records of 1,289 students who were registered in the offices of disabilities at three universities in the school years between 2001-2002 and 2004-2005. Students' files were deemed inactive based on the last year of enrollment in courses, and of the 1,289 students identified in this sample, 18.1% of the student's files were deemed inactive in the 2001-2002 school year, 24.8% were deemed inactive in the 2002-2003 school year, 25.8 percent were deemed in active in the 2003-2004 school year, and 31.3% were last enrolled during the 2004-2005 school year.

Of the participants (N=1,287), slightly more were male (53.3%) than female (46.7%), and ages ranged from 17 to 67 years of age (N= 1,279, X=26.13, SD=7.515). Student age was determined by using the student's birth date to calculate his/her age on May 1st of the school year during which the file was deemed inactive. Students self-identified ethnicity in

the following ways (N=1,281): White/Non-Hispanic (76.0%); Black/ Non Hispanic (11.4%); Asian/ Pacific Islander (5.7%); Hispanic (5.9%); and Native American or Alaskan Native (0.9%). For purposes of conducting logistic regression, ethnicity was also classified into two categories; White/Non Hispanic (76%) and Minority (24%). Of the students, 82.3% were undergraduates and 17.7% were graduate students (N=1,274). Students' disabilities were categorized as one of three types: cognitive (55%); mental disorder (14%); and physical (31%). Table 1 illustrates the percentage of students by demographic characteristic and disability category.

Student Services

The disability services each student qualified for were documented during the data collection process. In the 1,289 files reviewed, most students qualified for extended test time and note-taking services. The results in Table 2 show the percentage of students qualifying for each type of service by disability type. It should be noted that some of the categories may appear to have only a small percentage of students qualifying for that service because not all services were offered by all universities, as previously indicated.

Table 1

Student Demographics by Disability (N=1,289)

	N	Cognitive Disabilities (n=709)	Mental Disorders (n=185)	Physical Disabilities (n=395)
Gender	1,287			
Male		56.9%	47.6%	49.5%
Female		43.1%	52.4%	50.4%
Ethnicity	1,281			
White/Non Hispanic		76.4%	74.6%	74.4%
Black/ Non Hispanic		10.7%	10.8%	12.7%
Other		12.6%	13.5%	11.9%
Student Status	1,274			
Undergraduate		83.5%	81.6%	80.3%
Graduate		16.5%	18.4%	19.7%
Age	1,289			
22 and Younger		27.2%	23.8%	17.7
23 - 30		60.8%	53.0%	53.9%
31 and Older		11.1%	23.2%	27.3%

Table 2

Student Demographics by Disability (N=1,289)

	All Students w/ Disabilities (N=1,289)	Cognitive Disabilities (n=709)	Mental Disorders (n=185)	Physical Disabilities (n=394)
Extended Test Time	79.9%	91.4%	82.7%	58.0%
Note-Taking Services	43.8%	48.5%	24.3%	44.6%
Distraction Reduced Tests	29.0%	37.4%	49.7%	3.2%
Assistive Technology	24.4%	20.9%	9.2%	38.0%
Flexibility in Due Dates	19.7%	17.5%	34.6%	16.7%
Accessible Classrooms	14.0%	4.8%	4.9%	34.9%
Learning Strategies	17.0%	25.1%	16.8%	.8%
Classroom Assistants	10.1%	7.2%	3.8%	18.2%
Alternative Format	9.9%	7.8%	2.7%	17.2%
Physical Therapy/ Functional Training	6.9%	1.8%	0.0%	19.2%
Transportation	6.4%	2.0%	1.6%	16.7%
Support Group/Counseling	3.7%	2.1%	14.1%	1.8%
Course Waiver/ Substitution	3.3%	4.2%	1.1%	2.5%
Residential Hall	2.6%	.8%	1.1%	6.3%
Interpreting Services	2.0%	.6%	.5%	5.3%

Hierarchical Comparison of Models

Of the students whose files were reviewed, 74.2% of the students graduated (N=1,289). The proportion of students graduating for each disability type are: cognitive (73.8%); mental (69.7%); and physical (77%). In the logistic regression analysis, graduation status was the outcome variable scored as yes/no (1=yes, 0=no). The predictor variables were grouped into two types: student characteristics and disability services. Initially, the two types of predictors were entered into the regression equation in a hierarchical fashion, with student characteristics entered first and student disability services entered second. This produced results for two models: the model using only student characteristic data as predictor variables and the model using all available information. By entering the variables into the model in this way, it is possible to compare the two models using a drop-in deviance test to determine whether the disability services provided to the student affect the probability a student graduates.

The model including only student characteristic predictor variables had a -2 Log Likelihood statistic of 1,347.66. Gender, age, and student status (graduate *versus* undergraduate student) were found to be statistically significant in predicting graduation among students with disabilities. By comparison, when disability services were added in model II, the demographic variables gender, age, and disability type were statistically significant, as well as the disability services predictor variables alternative format tests, assistive technology, classroom assistants, distraction reduced testing, flexibility in assignment and test dates, learning strategies, and physical therapy/functional training. The addition of student services to student characteristics in model II reduced the -2 Log Likelihood by 181.01 to 1,166.65.

Using the drop-in deviance test to compare models I and II, the resulting test statistic was 181.01 ($df = 15$; $p < .05$). We conclude that Model II, the model including both demographic characteristics and the disability services available to the student, is a more appropriate model for the data than the model with demographic characteristics alone. In terms of prediction ability, model I was able to correctly predict the graduation status of students with disabilities 75.1% of the time, while model II was able to do so 79.7% of the time. The summaries of analyses are shown in Table 3.

Final Model and Interpretation of Coefficients

As a follow-up to the comparison of models I and II, the model was refined to include only the variables that seemed to contribute substantially in predicting whether a student would graduate. A stepwise selection procedure was used to add or remove variables from the logistic regression model according to the AIC criterion. Starting with the model that includes all predictor variables, individual variables were added or removed from the regression model based on whether the new model would have a lower AIC statistic, indicating a better fit of the model to the observed data. The final model that resulted from this procedure included the characteristics male, age, and disability type, as well as the disability services alternative format tests, assistive technology, classroom assistants, distraction reduced testing, flexibility in assignment and test dates, learning strategies, note-taker services, and physical therapy/functional training. This final model was able to correctly predict the graduation status of students 79.9% of the time. Those results are shown in Table 4.

To discuss the interpretation of the coefficients in the final model, we will begin with the interpretation for student characteristic variables and then for the disability services variables. The odds that a female student graduated were approximately 1.5 times larger than a male student with identical characteristics and disability services. Additionally, the odds that a student would graduate was 5.4 times larger for students whose age was between 23 and 30 than a student whose age was between 15 and 22, while the odds was 2.9 times larger for students whose age was 31 and above. Students with a cognitive disability were only one half as likely to graduate as a student with a physical disability, and students with a mental disability were only one third as likely to graduate as a student with a physical disability. Students qualifying for tests and assignments in an alternative format were 1.8 times more likely to graduate than students not qualifying for this accommodation. The odds that a student qualifying for a distraction-reduced testing environment would graduate was 4.2 times larger than for a student without this service. Students qualifying for flexible assignments and test dates were 2.5 times more likely to graduate then students without this resource. Learning strategies were associated with a student being 2.4 times more likely to graduate, while students qualifying for physical therapy were 3.5 times more likely to graduate than students not qualifying for this treatment. In the same vein, students qualifying to receive assistive technology in the classroom, classroom assistants, or note-taker services were approximately 20% to 40% less likely to graduate than students not qualifying for those services.

Discussion

Prior to discussing the results of the study in the context of the input-environment-output college impact model, it is important to note the assumptions and limitations of this study. The major assumption in this study was that all students with disabilities attending the universities asked for the accommodations they needed to graduate and actually utilized the accommodations for which they had become eligible. The major limitation of this study was that the universities participating were not randomly selected, so the results technically apply only to the universities involved. However, it seems reasonable that similar patterns would hold for comparable Midwestern, four-year,

Table 3

Logistic Regression of Student Graduation (N=1,274)

	Model I			Model II		
	β	Odds Ratio	Odds Ratio 95% CI	β	Odds Ratio	Odds Ratio 95% CI
Block 1: Student Characteristics						
Gender (Male)	-.55***	.58	0.44-0.76	-.42**	.66	0.49-0.89
Age (ref=22 and Younger)						
23-30	1.40***	4.03	2.98-5.47	1.74***	5.67	4.00-8.03
31 and Older	.43*	1.53	1.04-2.26	1.19***	3.28	2.09-5.13
Ethnicity (ref=White)						
Minority	-.06	.94	0.69-1.27	-.22	.80	0.57-1.12
Disability (ref=Physical)						
Cognitive	-.11	.89	0.66-1.22	-.61**	.54	0.37-0.80
Mental	-.33	.72	0.48-1.08	-1.19***	.30	0.18-0.51
Student Status (Graduate)	.44*	1.56	1.07-2.27	-.14	.87	0.57-1.32
Block 2: Student Services						
Accessible Classroom				-.24	.79	0.48-1.28
Alternative Format				.69*	1.99	1.09-3.64
Assistive Technology				-.36*	.70	0.50-0.99
Classroom Assistants				-.53	.59	0.38-0.93
Course Waiver/Substitution				-.40	.67	0.25-1.77
Distraction Reduced Testing				1.44***	4.22	2.73-6.51
Extended Test Time				.34	1.41	0.95-2.09
Flexibility in Due Dates				.99***	2.69	1.68-4.31
Interpreting Services				.62	1.86	0.59-5.89
Learning Strategies				.94***	2.57	1.47-4.50
Note-Taking Services				-.30	.74	0.55-1.00
Physical Therapy/Functional				1.95*	7.04	1.25-39.52
Residential Hall				-.74	.48	0.08-2.86
Support Group/Counseling				-.05	.96	0.27-3.20
Transportation				-.16	.86	0.16-4.66
-2 Log likelihood		1347.66			1166.65	
Nagelkenke R Square		.12			.30	

Notes: p<.05=*, p<.01=**, p<.001=***

Table 4

Logistic Regression of Student Graduation (N=1,282)

	Model III		
	β	Odds Ratio	Odds Ratio 95% CI
Gender (Male)	-.42***	.66	0.49-0.88
Age (ref=22 and Younger)			
23-30	1.68***	5.37	3.82-7.55
31 and Older	1.08*	2.95	1.93-4.49
Disability (ref=Physical)			
Cognitive	-.53	.59	0.41-0.84
Mental	-1.17	.31	0.19-0.50
Alternative Format	.59	1.80	1.01-3.19
Assistive Technology	-.37	.69	0.49-0.97
Classroom Assistants	-.52	.59	0.39-0.92
Distraction Reduced Testing	1.44	4.21	2.77-6.42
Flexibility in Due Dates	.95	2.58	1.63-4.06
Learning Strategies	.89	2.43	1.42-4.17
Note-Taking Services	-.25	.78	0.58-1.04
Physical Therapy/Functional	1.27	3.55	1.42-8.85
-2 Log likelihood		1185.84	
Nagelkenke R Square		.29	

Notes: p<.05=*, p<.01=**, p<.001=***

public universities. Additionally, only two of the universities participating in the study documented both the students' primary and secondary disabilities, and as a result, only students' primary disability was identified. The extent to which students' secondary disabilities impact learning is beyond the scope of this study. Other limitations include the lack of a comparison group of students with disabilities who did not register for services, the inability to collect qualitative data from students, and the inclusion of only demographic variables as student characteristics. For example, other student characteristics such as talents, experiences, academic achievements, and aptitude scores may have influenced student outcomes.

Last, there was no way to determine the quality of interactions of students with disabilities and office personnel, professors, family, and/or other persons in their environments. This limitation takes on particular salience relative to the finding that the graduation rate for students qualifying for disability services at university C in this study was 44% higher than the graduation rate for students qualifying for services at university A and 36.9% higher than students qualifying for services at university B. The graduation rates of students qualifying for disability services at university A and B were more consistent with the 53% graduation rate reported by the United States Department of Education for students with disabilities attending postsecondary institutions throughout the country (Horn & Berktold, 1999). While university C's graduation rate may be due to the institution's strict admission requirements and overall higher graduation rates of students, additional factors might explain the difference in graduation rates, such as students' self-advocacy skills, self-esteem, and self-determination. Identifying those factors was not possible in this study, primarily due to the anonymity

given to each university as a condition of participation in the study as well as to the archival nature of the data collected. Despite these limitations, the model of variables that predicted graduation among college students with disabilities in this study warrants discussion.

Student Characteristics Favoring Graduation

Females and students 23 years of age and older were more likely to graduate than their male and younger counterparts, respectively. The finding that females and students 23 years of age and older are more likely than males and younger students to graduate seems consistent with national statistics, especially when one considers that graduate students were included in this sample. The national statistics show that there are many more female graduate students with disabilities than male graduate students with disabilities, and on a whole, graduate students are 24 years of age and older (NCES, 2010). In addition, females are more likely than males to report mental disorders, especially depression (NCES, 2006). Within the context that individuals with mental disorders are often on medications that may interfere with cognition, concentration, and planning, females with mental disorders may have benefited more than males from distraction reduced-testing, flexible due dates, alternative format tests, and learning strategies. In contrast to this explanation, it may be that medications alone contributed to the graduation rates of females.

Students with physical disabilities were more likely to graduate than students with cognitive or mental disabilities. This finding may have been influenced by the fact that students with physical disabilities are less likely to experience cognitive functional limitations, such as decoding impairments or restricted attention or memory abilities, which likely influence the use of accommodations and graduation patterns of students with cognitive and mental disorders (Rehabilitation Services Administration [RSA], 2006).

Disability Services Favoring Graduation

The odds of graduating were best for students who qualified for distraction-reduced testing. This accommodation is often provided to students who experience high levels of distractibility when exposed to certain auditory or visual stimuli. This distractibility can impact students' cognitive processing and can cause anxiety-related reactions. Findings of this study suggest that students with disabilities may greatly benefit from settings that minimize extraneous stimuli, and this may be especially true for students with ADHD and mental disorders.

Alternative format tests, flexibility in assignment and test dates, learning strategies/study skills assistance, and physical therapy/functional training were also significant predictors of student graduation. The finding that learning strategies/study skills assistance significantly improved the odds of graduation seems consistent with student reports that time management and test-taking strategies contribute the most to their success in college (Getzel et al, 2004). Additionally, while physical therapy is not usually a service provided by most university disability offices, it seems to be a very significant factor in predicting student graduation. Based on this finding, university disability offices may want to consider the benefits of providing physical therapy, recreation, and functional training services to their students.

Extended test time was not a significant explanation of graduation in this study, which is inconsistent with findings in previous studies that show this factor improves test scores (Jarvis, 1996; Ofiesh, 2000; Runyan, 1991a, 1991b; Weaver, 2000). Eighty percent of students who participated in the study qualified for extended test time, and of those, the following types of disabilities were represented: cognitive disabilities (91%), mental disorder (83%), and physical disability (58%). It may be that students in one of the disability categories or a subgroup of students in the disability category who qualified for extended time may not benefit from this service. Additionally, the findings in this study did not support previous findings that indicate course substitutions are significant predictors of graduation (Skinner, 1999).

Odds Against Graduation

Assistive technology, classroom assistants, and the use of note-taking services decreased the odds of college graduation for students with disabilities. This does not necessarily indicate these services are detrimental to student graduation, but it simply means that students qualifying for these services are less likely to graduate. Therefore, disability service personnel may want to coordinate specifically with students qualifying for these services to determine additional supports they need to succeed in higher education. Within the context that assistive technology decreased the odds of students graduating, several explanations seem plausible.

First, universities may fail to provide students with the individual attention they need to access available technology. Second, universities may not have adequate funding to provide the most up-to-date, useful technology. Last, universities may fail to provide the type of training students need in order to utilize available technology in an effective manner (Parker & Banerjee, 2007). Students who qualify for assistive technology accommodations may also have more significant disabilities, and as a result, they may encounter additional obstacles that contribute to the lack of success in college.

The results in this study show that classroom assistants and note-taking services also decreased the odds of graduation for students with disabilities. This may be due to the possibility that the correlation between type of disability and service provision results in more challenges than benefits for students. Also, students' success may be negatively impacted if they must rely on unqualified assistants, and in addition, it seems plausible to speculate that a volunteer's note-taking may be less accurate than those of a paid note-taker, teaching assistant or professor. The quality of notes can be extremely important to students reviewing course material or preparing for an exam. In the current study, paid and unpaid note-takers provided services to students.

Based on the results in this study, disability office personnel may want to review training procedures and personnel selection related to classroom assistants and note-takers in order to ensure these assistants are able to provide the quality of services students need to have academic success. In general, the accommodations that were negatively correlated to student graduation are typically services students with more significant disabilities use; therefore, there may be more obstacles to their success at the university. Regardless, assistive technology, note-taking services, and the use of classroom assistants are services that students with significant disabilities often need.

Implications

The results in this study contribute to the evidence about the services and accommodations college students with disabilities seem to need in order to graduate. The model of variables that predict graduation for students with disabilities in this study provides those in university disability offices with information that can help them enhance the graduation rate among students with disabilities. In this process, it will be important to examine the services and accommodations that decrease the odds of college graduation for students with disabilities. This knowledge lays the foundation for the development of postsecondary and governmental policies that promote the institutional services for students with disabilities.

The major implication of this study is for more research that tests the model identified herein using a similar sample of students with disabilities in 4-year institutions of higher education, as well as testing the model in 2-year institutions. Beyond testing this model, additional models are needed that identify the extent to which particular traits and characteristics of students, such as self-determination, self advocacy, and motivation, increase the odds of college graduation for students with disabilities, including additional outcome measures such as GPA at graduation and attendance while enrolled in school. Similar studies are needed to explore disability-related services that predict graduation for students with the following disabilities: attention deficit disorder; blind/ low vision; deaf/ hearing impairment; learning disability; mental disorders; and mobility, systemic, and disease-related disabilities.

In the meantime, practitioners in university settings can use the results of this study to develop strategies in the areas of curriculum, campus accessibility, student affairs, and disability services. Practitioners, including academic administrators, supportive personnel in disability offices, and professors, can make programmatic decisions and create instructional environments that are most appropriate for and helpful to particular groups of students with disabilities. In order for practitioners to make decisions that enhance the likelihood of graduation for students with disabilities, they will need the support of key university personnel.

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