STEMPS Faculty Publications   STEM Education & Professional Studies

2023

Comparing the "Value of Information Services" for Providers and Vulnerable Patrons: A Mixed-Methods Study with Academic Libraries and Students with Disabilities

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Comparing the "value of information services" for providers and vulnerable patrons. A mixed-methods study with academic libraries and students with disabilities

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DOI: https://doi.org/10.47989/ir283198

Abstract

Introduction. This multi-year, mixed-methods study compares (a) the reasons administrators and librarians of academic libraries invest in assistive technology for delivering information services to students with disabilities, with (b) the benefits that influence these students' intention to use AT.

Method. In the first phase, 50 library administrators and 22 librarians from 186 public universities across the US shared their top-three reasons for investing in assistive technology through a qualitative survey. In the second phase, 322 students with disabilities from the same institutions completed a quantitative survey, in which respondents shared individual-level benefits that influence their intention to use assistive technology.

Analysis. We utilised thematic analysis and structural equation modelling to analyse data in the first and second phases, respectively.

Results. Three individual, three organisational, and three societal benefits prompt academic libraries' investment in assistive technology. However, only two individual benefits – increasing information literacy and completing academic tasks – significantly influence the intention of students with disabilities to use the technology. In addition, neither academic libraries nor students, perceive the technology to be valuable for enhancing autonomy and the self (i.e., self-esteem, self-efficacy, and self-image) of students with disabilities.

Conclusion. Implications for academic libraries that provide information services to students with disabilities are discussed at the end.

Introduction

Students with disabilities are sceptical of academic institutions' ability to provide valuable accommodations (Brunskill, 2021), especially since institutions seldom provide accessible digital resources (Pionke and Manson, 2018). Inaccessible electronic resources impede students' processing of information for learning (Beyene, 2019). Although federal laws (e.g. Americans with Disabilities Act [ADA], Rehabilitation Act) mandate accommodations such as assistive technologies (AT), students with disabilities have shared that faculty members sometimes view them as disadvantageous to nondisabled students and refuse to implement them (Sarrett, 2018). Assistive technology refers to *'any item, piece of equipment, software program, or product system that is used to increase, maintain, or improve the functional capabilities of persons with disabilities'* (Assistive Technology Industry Association, 2019).

In response to these challenges experienced by students with disabilities, academic libraries increasingly provide numerous technologies for delivering information services to patrons (Reid and Kennan, 2017). Information services afford patrons access to information and assist them in creating, storing, and using information (Corrall, 2000; Potnis et al., 2017). In addition, using information empowers vulnerable populations to participate in everyday life (Potnis, 2015). For students with disabilities, a vulnerable population studied in our research, information services provided through assistive technology can help them mitigate a combination of visual, hearing, cognitive, and physical impairments (Calvert et al., 2019; Hernon and Calvert, 2006). Given these potential benefits, academic libraries increasingly invest in this technology to better serve students with disabilities.

The benefits provided through any service are the value (Vargo and Lusch, 2004, 2008, 2016). An information service's value is based on its affective meaning or explicit use (Drosopoulou and Cox, 2020). Most information services that employ assistive technology facilitate the browsing and retrieval of information by students with disabilities through the direct use of those tools. For instance, the use of the technology improves users' access to and use of data stored in scholarly databases (Xie et al., 2015). Students with disabilities use screen readers (e.g. JAWS [Job Access with Speech], ZoomText), captioning tools, speech recognition applications (e.g. Nuance Dragon, Read and Write Gold, Sonix), adaptive keyboards (e.g. BigBlu Kinderboard), trackballs, and adaptive joysticks. These tools enable students to seek, search, process, manage and use information for completing academic tasks (Babu and Xie, 2017; Belger, 2013; Forro, 2019; Moorefield-Lang et al., 2016). Accordingly, the American Library Association (2006) encourages academic libraries to provide assistive technologies since these technologies yield vast information benefits for students with disabilities.

Problem statement

Recipients find a service valuable if the benefits they expect from using it align with those received (Das and Bharadwaj, 2017; Islam et al., 2015). If academic libraries (a) are unaware of the benefits that students with disabilities expect from information services; (b) understand students' expectations but do not have the necessary assistive technologies for generating optimal value; or (c) inadequately respond to students' evolving information needs; the information services offered may not help these students (Potnis and Mallary, 2021a). This discrepancy in value generation can deter students with disabilities from using the information services offered by academic libraries, yielding a poor return on investment in the technologies. Nearly half of students with disabilities in the United States report that the information services offered by their academic libraries are insufficient or do not meet their needs (Galanek et al., 2018). Since academic libraries invest substantial resources in providing information services, they are under constant pressure to enhance their services (Heradio et al., 2012; Scupola and Nicolajsen, 2010; Zaugg and Warr, 2018).

Past studies have compared academic libraries and students' perceptions of information services (e.g. patrons' use of electronic resources) (Vilar and Zabukovec, 2016).

However, the value academic libraries anticipate creating when delivering information services to students with disabilities has seldom been compared with the benefits these students expect from using the information services.

Students with disabilities primarily access assistive technology through their academic libraries' information services (Potnis and Mallary, 2021a). Hence, the perceived benefits of the technolog reflect academic libraries' information services. Accordingly, this study treats assistive technologies as extensions of information services and investigates the following research questions:

- RQ1: *Which benefits of assistive technology are envisioned by academic libraries when offering information services to students with disabilities?*

- RQ2: *Which benefits of assistive technology significantly influence the intention of students with disabilities to use them as part of academic libraries' information services?*

Value of assistive technology and related information services

Communication and mobility

The fundamental value of assistive technology envisioned by libraries is promoting the communication and mobility of students with disabilities (Mates, 2012). For example, libraries that provide assistive listening devices (e.g. FM transmitters), captioned telephones and video relay services, can help students with hearing loss process the auditory information they receive and generate responses (Riley, 2009). For Deaf and hard-of-hearing patrons of academic libraries, receiving text messages and utilising sign language allows them to converse with their faculty members, peers, and academic librarians (McNicholl et al., 2019). In addition, nonverbal autistic students may employ text-to-speech features built into their mobile devices (e.g. Apple iPad) to communicate fluently during interactions (Ashby and Causton-Theoharis, 2012).

Adjustable computer workstations, which typically feature screen magnification and reading software, oversized monitors, anti-glare screens, ergonomic keyboards, trackballs, and height-adjusting desks, help students with mobility impairments to access information services (Tripathi and Shukla, 2014). Mates (2012, p. 11) articulates the value of assistive technology for promoting the physical independence of students with disabilities: '*As long as a [disabled student] has control of one part of his or her body, whether a finger, an eye, or a smile, he or she can use a computer*'. Aside from using computers, students who use wheelchairs can independently navigate their campuses, including academic libraries (Rice et al., 2015).

Communication and mobility jointly comprise a fundamental value of assistive technology. which enables students with disabilities to benefit from using the information services provided by their institutions. We study the degree to which this value of the technology influences students' intention to use them.

> H1: *Being able to communicate and move positively influences the intention of students with disabilities to use assistive technologies and related information services.*

Information literacy

Information literacy refers to a student's ability to access, process, manage, and use information (Association of College and Research Libraries, 2016). Assistive technology can help students with disabilities build information literacy (Stauter et al., 2019). For example, captioning services ensure that students with hearing loss receive enough visual information during lectures to compensate for missing auditory cues (Lartz et al., 2008). Students with dyslexia may use Smart Pen devices to record and manage information for studying (Joyce & Boyle, 2020). Screen reading software applications (e.g. JAWS, ZoomText) may help blind and visually impaired students process and use information by magnifying their screens' contents (Southwell and Slater, 2013). To support students' reading fluency, audiobooks (Floyd

and Judge, 2012) and text-to-speech applications (Tanners et al., 2012) read textual information aloud at a comfortable pace. Given these potential benefits, our study determines whether students with disabilities perceive assistive technology to be valuable in helping them increase information literacy and if their perceptions indicate their intention to use assistive technologies.

> H2: *Being able to increase information literacy positively influences the intention of students with disabilities to use assistive technology and related information services.*

Academic tasks

Being able to read and write with the support of assistive technology helps students with disabilities take notes during lectures (Malcolm and Roll, 2017), discuss materials with their peers (Pacheco et al., 2018), complete written assignments (Soorenian, 2013), and take examinations (Kernohan, 2008). Document magnification devices help visually impaired students read the material needed to complete their assignments (Calvert et al., 2019). When used alongside applications designed to support reading, writing fluency software such as Dragon Naturally Speaking (Nelson and Reynolds, 2015), enables students with visual, hearing, and cognitive impairments to produce quality writing due to these tools' word prediction and spell-checking functions (Falloon, 2016). In addition, students with traumatic brain injuries may use Kurzweil to find definitions of unfamiliar words (Kernohan, 2008). Since assistive technologies potentially enable students with disabilities to complete academic tasks, we investigate whether their perceptions of these tools influence their intention to use them.

> H3: *Being able to complete academic tasks positively influences the intention of students with disabilities to use assistive technologies and related information services.*

Autonomy and the self

Autonomy is defined as someone's ability to manage their schedules, complete routine tasks, and set achievable goals for solving problems (Peterson-Karlan, 2015). Students with disabilities become autonomous by building information literacy, completing academic tasks, or both (Adefila et al., 2020). Autonomy is related to a learner's self, notably their self-esteem, self-efficacy, and self-image (Elias and Merriam, 2005). Students with disabilities who spend significantly more time completing assignments than their nondisabled peers may feel anxious, possess poor self-esteem, and believe that they cannot complete academic tasks (Lambert and Dryer, 2018). For students with disabilities, feeling frustrated when completing assignments can contribute to poor self-efficacy, a prerequisite for managing time and sustaining motivation (Ben-Naim et al., 2017). Suppose assistive technologies are not provided to students with disabilities or are ineffective. In that case, students' self-image may be impeded, making them believe they do not belong in higher education (Jain et al., 2020). Graduates with disabilities can use assistive technologies to excel in their employment and solve everyday problems (Stumbo et al., 2009). Given these concerns, this paper examines whether students' perceptions of the value of the technologies for promoting autonomy and self will influence their intention to use them. Hence, we propose additional hypotheses:

> H4: *The ability to enhance autonomy positively influences the intention of students with disabilities to use assistive technologies and related information services.*

> H5: *The ability to enhance the self (e.g. self-efficacy, self-esteem, self-image) positively influences the intention of students with disabilities to use assistive technologies and related information services.*

Value pyramid

The benefits of assistive technologies and related information services presented in Sections 2.1, 2.2, 2.3, and 2.4 are hierarchical. Hence, we propose a value pyramid that illustrates the relationships among the four benefits (Figure 1). This pyramid's base is the communication and mobility of students with

disabilities, representing one of the most fundamental benefits of assistive technologies (Mates, 2012). As students utilise the technologies, their proficiency in searching, seeking, processing, managing, and using information increases (Stauter et al., 2019). Strengthened information literacy can help students with disabilities complete academic tasks, including attending classes, submitting assignments, and completing examinations (Peterson-Karlan, 2015). Students with disabilities who submit their assignments are likely to possess considerable self-esteem (Lambert and Dryer, 2018). Confident students with disabilities are also empowered to participate in social gatherings and exploit career opportunities upon graduation (Jain et al., 2020). Thus, benefiting from information services can improve students' quality of life and promote their independence. This autonomy can bolster the self-esteem, self-image, and self-efficacy of students with disabilities (Adefila et al., 2020). We propose the value pyramid (Figure 1) for representing the individual-level benefits of delivering information services via AT.
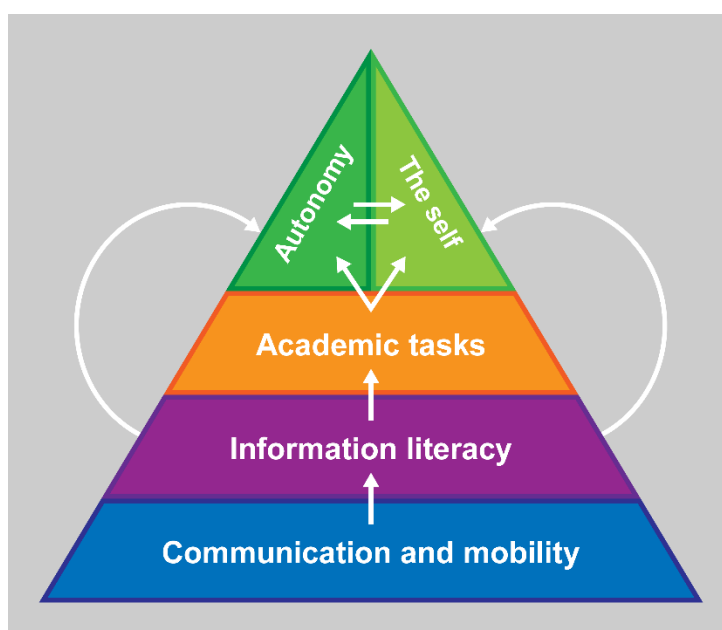
Figure 1: Value pyramid showcasing individual-level benefits of AT and related information services for students with disabilities.

Past research primarily reports the individual-level benefits of delivering information services to students with disabilities through assistive technologies. However, rarely has any study elicited academic libraries' motives for providing the technologies to students with disabilities. To address this gap, our research takes a service provider-user approach by comparing libraries' and patrons' perspectives on the benefits of providing assistive technologies for making information services most valuable for students with disabilities.

Mixed-methods research design
Phase 1: Qualitative data collection and analysis

To understand the information service provider's perspective, in 2018, we contacted 186 administrators and 321 librarians belonging to academic libraries in 186 public universities listed in the US News & World Report's (2018) publication, "Best National Universities." We emailed these individuals the link to a qualitative survey we built in Qualtrics. This paper shares participants' responses to the following survey items:

- What is the operating budget of your library in this fiscal year?

- What is your job title?

- Does your library have any assistive technologies?

- What are the top three assistive technologies used by patrons in your library?

- What are your top three reasons for investing in and serving students with disabilities using assistive technologies?

Two weeks later, we followed up with a gentle reminder to potential respondents. We received 50 and 22 complete responses from the administrators and librarians, respectively, with a cumulative response rate of 14.2%.

To analyse the detailed responses from library administrators and librarians, we employed a thematic analysis technique developed by Ritchie and Spencer (1994), which has been applied in recent studies (Drosopoulou and Cox, 2020; Parbhoo and Fourie, 2017). Our coding process consisted of six stages: familiarising ourselves with data, generating initial codes, searching for themes, reviewing themes, defining, and naming themes, and producing the final analysis.

Phase 2: Quantitative data collection and analysis

To understand the perspective of students with disabilities, in 2019, we reached out to the administrators responsible for offering assistive technologies to students with disabilities in the same 186 institutions in the first phase. We invited these administrators to distribute our online, quantitative survey (Appendix) measuring the influence of the perceived benefits of assistive technologies (e.g. communication and mobility, information literacy, completing academic tasks, achieving autonomy, and supporting the self) on the intention of students with disabilities to use the technologies provided by their institutions. Our survey tested the five hypotheses depicted in the theoretical model (Figure 2).
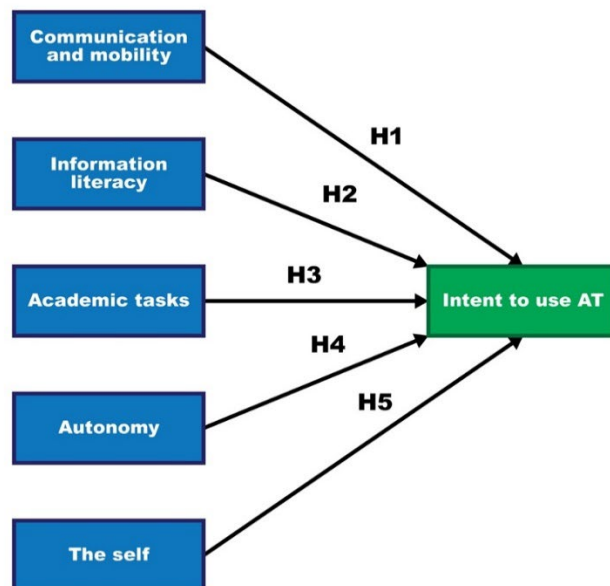

Figure 2: Theoretical model

When developing our quantitative survey, we referred to five instruments used by clinical practitioners who work with disabled populations. First, we consulted the Craig Handicap Assessment and Reporting Technique (CHART) because this instrument is designed to measure respondents' physical mobility, cognitive functioning, and social participation (e.g. obtaining an education, maintaining employment, building friendships) (Whiteneck et al., 1992). Second, the World Health Organization's Disability Assessment Schedule (DAS) 2.0 measures disability per the International Classification of Functioning, a valuable framework for understanding disability (2018). Third, we consulted the Perceived Handicap Questionnaire (PHQ) since the instrument measures respondents' perceptions of their abilities (Tate et al., 1994). Finally, we reviewed the Assistive Technology Device Predisposition Assessment (ATDPA) and Educational Technology Predisposition Assessment (ETPA) since they both measure the technology needs of students with disabilities and barriers to optimal use (Institute for Matching Person & Technology, 2021). Past studies have applied and validated the CHART, DAS 2.0, PHQ, ATDPA, and ETPA instruments (Hughes-Roberts et al., 2019; Perenboom and Chorus, 2003; Scherer et al., 2005; Wang et al., 2016).

To analyse the responses of students with disabilities to our quantitative survey, we used structural equation modelling, specifically confirmatory factor analysis and path modelling techniques. Details regarding our statistical analyses follow.

Findings

Phase 1: Incentives for academic libraries to invest in assistive technologies

In the first phase, all the respondents confirmed working in academic libraries with an operating budget greater than one million dollars. Job titles of administrators include dean (n = 19), director (n = 11), strategist (n = 2), unit head (n = 11), and associate librarian with administrative responsibilities (n = 7). Librarians in our study are employed in services related to access, instructional technology, reference, user experience, community outreach, and distance learning. All respondents confirmed serving their library patrons using AT.

The most popular assistive technologies provided by respondents' academic libraries include JAWS, Kurzweil, CCTV magnifier (e.g. Topaz, Voyager Visualtek), ZoomText, multi-coloured QWERTY keyboard layout, Braille embosser, Adjustable height workstations, door operators, Dragon Naturally Speaking, SensusAccess, ADA-compliant print release stations, OpenBook, and Read & Write Gold.

Answering research question 1

Table 1 presents the individual, organisational, and societal benefits of providing assistive technologies as academic library administrators and staff members reported. These anticipated benefits motivate academic libraries to invest in assistive technologies for delivering information services to students with disabilities. It is worth noting that library administrators and staff envision individual-level benefits are not limited to students with disabilities; stakeholders believe that disabled faculty and staff members also benefit from using the technologies.

Sample direct quotations (by library administrators and librarians)	Value of AT	Type of value
● Support students who require AT to use information resources; Facilitate unmediated use of our information services ● To assist students in locating and using information responsibly ● Libraries – scanners – for converting materials to a digital format ● Improve access to an array of collections and services ● Commitment to [information] access and service	Serve through information: Facilitating access to and use of electronic resources	Individual-level: "Information literacy" in the value pyramid (Figure 1)
● To help students with disabilities succeed academically; To remove barriers to students' academic success; Provide all students with tools needed to reach academic goals; To support student success; Make academic work easier for students with disabilities ● Enhance learning for all ● Promote faculty success ● Facilitating research ● IT placed equipment – access to perform educational tasks	Support teaching and learning: Equipping students and faculty for academic success	Individual-level: "Academic tasks" in the value pyramid
● Universal Design; Create an environment under the theory of Universal Design principles ● Meet the needs of library users; Meet student/staff need; Anticipating current and future need (our disabilities office has 900+ registered); Meet community need; Staying up to date with accessibility needs ● Student demand; Provide access on demand ● To help students physically and technologically navigate the building ● Optimal user experience	User-centric information services: Creating and maintaining a user-centred environment	Individual-level: "Communication and mobility; Information literacy; and Academic tasks" in the value pyramid
● It fits the libraries' mission to provide information to all; Helps us fulfill our mission; Part of our mission is to be accessible ● To leverage the library's central location and many service hours to offer beneficial services ● It's an investment in the future for our student community ● Set an example for campus ● Compliance with University standards for serving disabled students ● We have it as a priority in our planning	Serving students with disabilities as an organisational strategy: A strategic investment in the future	Organisational

● Partnership with our Disability Resource Center; Maintain partnership with the campus disability office ● Support disability services ● Strong academic disability program at our institution	Community building in academic institutions: Partnering with stakeholders of information services on campus	Organisational
● For providing more reliable and responsible service ● To enhance accessibility for persons with disabilities ● To provide more comprehensive service	To enhance the quality of information services offered by academic libraries	Organisational
● Diversity is a must ● Make our collections, services, and facilities available to all ● Help level the playing field for students with disabilities ● The campus commitment to equity; To provide equitable access for students with disabilities; Our campus is committed to providing an equivalent education for all students ● Fighting for social justice	Diversity and equity: Aiming, planning, and delivering service to achieve equity	Societal
● Provide inclusive study/workspaces; Inclusiveness; To offer useful tools for all members of the university community; To promote a welcoming and inclusive environment ● It's the right thing to do to provide access for all; It is the humane and the right thing to do; Moral obligation to serve everyone ● Ethics ● Ensuring we meet accessibility standards as a public university ● Making resources accessible to all ● Public patrons can also utilise [our AT] equipment their public library may not have access to	Inclusion: Ethical and moral obligations of libraries to serve everyone in the society	Societal
● Provide equal access to materials as mandated by law; Legislative mandates; Legal obligations ● Comply with the law, ADA ● Exceed ADA minimum requirements ● To avoid legal action	Legal compliance	Societal

Table 1: Values of AT: Service provider perspective

Phase 2: Benefits influencing the intention of students with disabilities to use assistive technologies

In the second phase of our mixed-methods study, 322 students with disabilities completed our quantitative survey. Respondents reported the following impairments: cognitive (e.g. attention-deficit/hyperactivity disorder, autism, anxiety, depression, dyslexia, post-traumatic stress disorder, traumatic brain injury), physical (e.g. mobility issues, speech impediment, diabetes), hearing loss, visual impairment, and other impairments. Other impairments included various learning disabilities (e.g. dysgraphia, dyslexia, dyspraxia), psychological disorders (e.g. bipolar, borderline personality, obsessive-compulsive disorder), autoimmune diseases (e.g. cancer, fibromyalgia, lupus), epilepsy and seizures, and sleeping disorders (e.g. insomnia, narcolepsy). Figure 3 presents the distribution of impairments among all students who completed the survey. Around 52% of respondents possess more than one impairment.
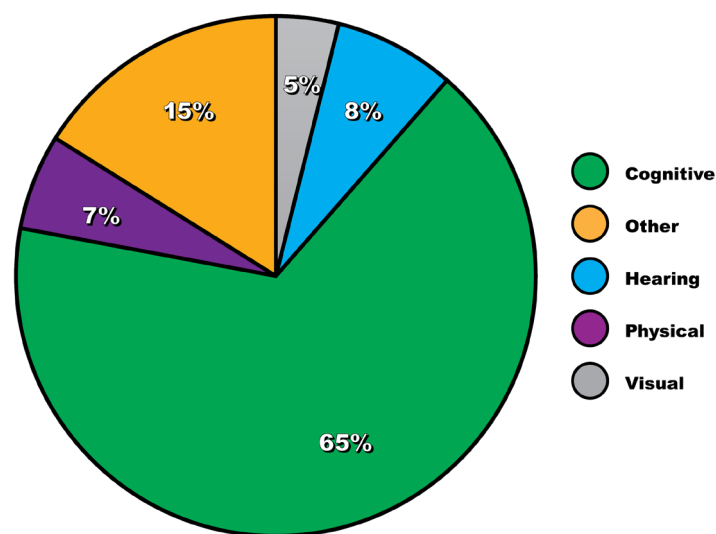
Figure 3: Impairments reported by respondents

Confirmatory factor analysis

We performed a confirmatory factor analysis and constructed a measurement model within the Amos 27 software application to analyse data collected with our quantitative survey. Crafting a measurement model involved diagramming latent constructs and their respective indicators and residual components. To estimate the correlations among the indicators in our survey with their associated latent constructs, we utilised the maximum likelihood method since responses to our survey's items were normally distributed (Brown, 2015). Table 2 lists estimated factor loadings for each observed indicator measured in our survey. Every factor's Cronbach's alpha value was greater than 0.80, confirming that the relationships among indicators and their constructs are significant (Babbie, 2015).

	Observed indicator	Latent construct	β	SE.
1.	Move	Communication and mobility	.75	
2.	See or hear		.83	.07
3.	Speak		.87	.07
4.	Write		.83	.07
5.	Navigate campus		.79	.08
6.	Alternative formats	Information literacy	.69	
7.	Search		.77	.08
8.	Process		.76	.08
9.	Comprehend		.86	.09
10.	Evaluate		.83	.09
11.	Note-taking	Academic tasks	.82	
12.	Assignments		.85	.06
13.	Examinations		.77	.06
14.	Collaboration		.75	.06
15.	Socialize	Autonomy	.73	
16.	Comfortable pacing		.79	.08
17.	Quality of life		.83	.07
18.	Pursue careers		.77	.08
19.	Self-esteem	The self	.95	
20.	Self-efficacy		.90	.03
21.	Self-image		.92	.03
22.	Intend to use	Intent to use AT	.92	
23.	Plan to use		.95	.03
24.	Predict usage		.87	.04
25.	Expect to use		.87	.04

Table 2: Factor loadings

Path modelling for answering research question 2

After controlling for respondents' academic years, genders, and impairments, our model explains 16.7% of the total variance in the intention of students with disabilities to utilise assistive technologies. The following indices confirm the fitness of our model to the data we collected: Chi-squared ($\chi2$) = 1043.35, df = 419; comparative fit index (CFI) = .91; and root mean square error of approximation (RMSEA) = .07. Our model is a good fit based on the $\chi2$, CFI, and RMSEA indices (Kline, 2015).

Only the second and the third hypotheses were significant and supported (Table 3). Hypotheses 1 and 4 were not supported because their structural coefficients were both negative and insignificant. Therefore, we rejected the final hypothesis.

Factor	β	Sig.	Hypothesis supported?
H1. Communication and mobility	−.07	–	No
H2. Information literacy	**.17**	**$p < .001$**	**Yes**
H3. Academic tasks	**.27**	**$p < .05$**	**Yes**
H4. Autonomy	−.03	–	No
H5. The self	.07	–	No

Table 3: Structural coefficients

As depicted in Figure 4, our findings suggest that information literacy and completing academic tasks are significant predictors of the intention of students with disabilities to use assistive technologies provided by their institutions.
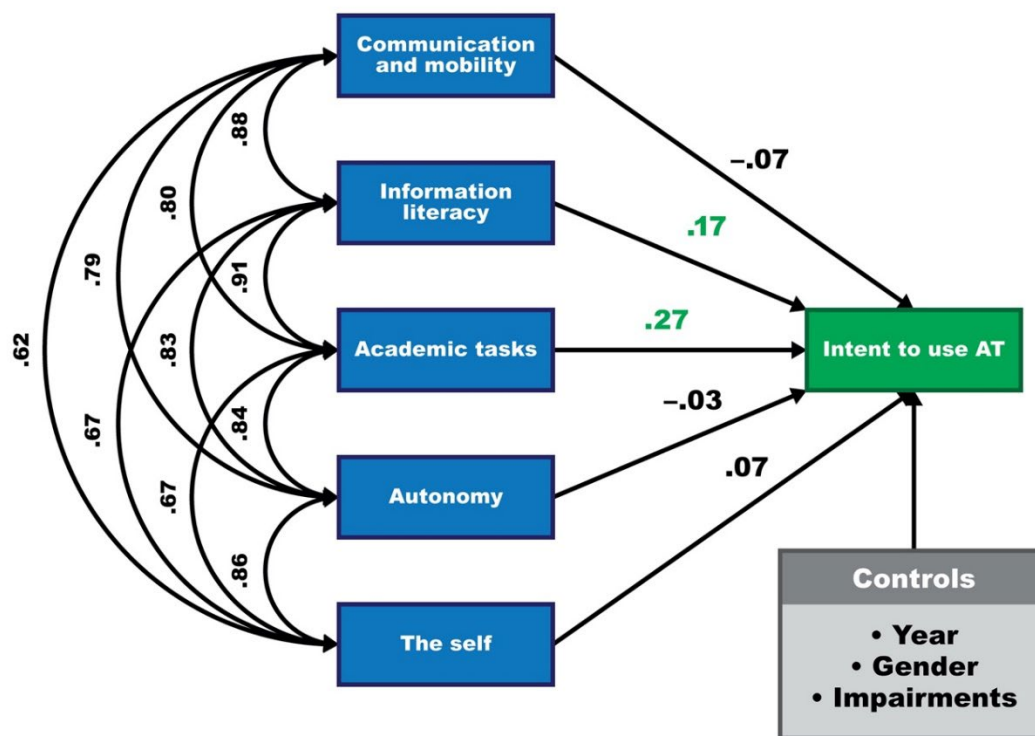
Figure 4: Path model

Discussion

This study is helpful for academic institutions and stakeholders who are interested in serving patrons with disabilities. For instance, the numerous benefits of assistive technologies revealed by administrators of academic libraries, academic librarians, and students with disabilities in this study can (a) guide the efforts of libraries interested in investing in assistive technologies, (b) help academic libraries make a stronger case for seeking funding and continued institutional support for investing in assistive technologies, (c) help libraries seek external grants from organisations like the Institution of Museum and Library Services for offering assistive-technologies-based information services, (d) influence the allocation of libraries' internal funds, (e) inform libraries' policies governing assistive-technologies-based information services, and (f) help vendors better understand academic libraries' investments in assistive technologies and the potential benefits for users.

Unrealised benefits

Past studies document the benefits of assistive technologies for enhancing communication (Mates, 2012), mobility (Tripathi & Shukla, 2014), information literacy (Stauter et al., 2019), completion of academic tasks (Malcolm & Roll, 2017), autonomy (Adefila et al., 2020), and the selves of students with disabilities (Lambert & Dryer, 2018). However, no single study reports all individual-level benefits of the technologies. Also, none of these studies were conducted nationwide. Our nationwide study found that only benefits related to information literacy and academic tasks significantly influence the intention of students with disabilities to use the technologies for receiving information services. The following sub-sections discuss the perceived benefits of assistive technologies and related information services, which service providers and their patrons do not realise.

Individual-level benefits

The foundational benefits of assistive technologies (e.g. communication, mobility), as well as the ultimate benefits (e.g. autonomy, the self) (Figure 1), do not significantly influence the intention of students with disabilities to use the technologies (Figure 4). Furthermore, academic library administrators and staff members do not consider the autonomy and the selves of students with disabilities when investing in assistive technologies (Table 1). This finding suggests that the providers and patrons in our study do not realise the ultimate benefits of the technologies and related information services for students with disabilities.

Academic library administrators and staff members must first realise the untapped potential of assistive technologies for achieving the foundational and ultimate benefits, and then communicate their value to all. This approach is likely to increase the awareness of students with disabilities, of the optimal values of assistive technologies, which may increase students' utilisation of information services. Past scholarship likewise recommends that information service providers communicate the value of their services to patrons (Drosopoulou and Cox, 2020).

Organisational benefits

In many US universities, academic libraries provide the space needed to install assistive technologies and make them available to students with disabilities (Potnis and Mallary, 2021a). In addition, academic libraries are the primary information service provider in several institutions (Potnis and Mallary, 2021b). Therefore, the increased usage of the technologies in institutions yields multiple benefits for academic libraries. For instance, greater utilisation helps academic libraries (a) support institutional diversity, equity, and inclusion initiatives (Guder, 2010); (b) secure additional funding for maintaining or expanding information services; (c) yield higher returns on investment in assistive technologies; and (d) bridge the service divide resulting from students' limited use of the technologies (Potnis & Mallary, 2021a). However, none of the administrators or librarians in our study reported (b), (c), or (d) as motivators for investing in assistive technologies.

The strategic role of AT in value-creation

Value-creation for patrons

Findings from our study inform the literature on the strategic role of technology in creating direct and indirect, short- and long-term benefits for both information service providers and patrons (Corrall, 2000; Yeh and Walter, 2017). For instance, providers like academic library administrators and librarians envision creating organisational and societal benefits by helping students with disabilities use information via AT. This finding confirms that assistive technologies are unique and indispensable tools academic libraries offer.

Students with disabilities possess a host of vulnerabilities. For instance, most of the impairments reported by students in our study (Figure 3) are physical and cognitive. Assistive technologies provided by academic libraries can help mitigate these impairments and enhance students' autonomy and selves. Thus, assistive technologies create optimal value for vulnerable patrons like students with disabilities.

Value-creation for information service providers

The benefits of assistive technologies (i.e., (a), (b), (c), and (d) in the first paragraph of the discussion, above) can inspire institutional interested parties (e.g. disability support services, faculty members) to collaborate with academic libraries. In addition, by complying with federal regulations (e.g. ADA, Rehabilitation Act) and their institutional policies, academic libraries can join other stakeholders in promoting the inclusion of students with disabilities.

Investing in assistive technologies can bolster academic libraries' influence within their institutions (Saunders, 2015). In our study, administrators and librarians believe that investing in and deploying assistive technologies can help advance their forward-thinking libraries (Corrall, 2000). Strategically using a library's facilities and offering beneficial

technologies during operating hours most convenient to patrons is crucial for serving the community and ensuring the library's longevity. Furthermore, by considering students' increased autonomy and self as benefits of assistive technologies, academic libraries that invest in assistive technologies are primed to create optimal value for students, faculty, and staff members with disabilities.

Value creation is a collaborative process among different actors (Srivastava and Shainesh, 2015). For example, academic libraries work with disability support and information technology services, among other stakeholders, to create value for students with disabilities (Potnis and Mallary, 2021b). Hence, to generate the most significant value for information services users, stakeholders must cooperate and help their students realise the untapped benefits of using assistive technologies (e.g. autonomy, self).

Value-driven investment

Our findings also advance scholarship on value-driven technological investments by information service providers like academic libraries (Kennan et al., 2014; Vargo and Lusch, 2016). This study suggests that the affordances of assistive technologies influence the value of information services for vulnerable patrons. For instance, academic libraries that provide assistive technologies for facilitating students' communication and mobility are less likely to be deemed "useful" than other libraries that invest in AT to strengthen students' information literacy and aid their completion of academic tasks.

Academic libraries need to involve students with disabilities, the primary users of assistive technologies, when evaluating, selecting, investing, and maintaining the technologies. Aligning service providers' and recipients' values is essential for generating higher returns on investment in services and related technologies (Das and Bharadwaj, 2017). In addition, academic libraries can involve patrons in co-creating value through meaningful dialogue (Vargo and Lusch, 2016).

Aligning values
Misalignment between the expected and actual benefits of using assistive technologies can deter students with disabilities from adopting them, resulting in an information service divide (Brannen et al., 2017; Carter, 2004; Cassner et al., 2011; Hernon and Calvert, 2006; Miller-Gatenby and Chittenden, 2000; Mulliken, 2017; Power and LeBeau, 2009). An EDUCAUSE survey revealed that 47% of students with disabilities enrolled in colleges and universities across the US perceive that their institutions invest in assistive technologies, which have little or no value (Galanek et al., 2018). Students may be unaware of the benefits of the technologies offered by their academic institutions since they seldom know the extent of their institutions' information services (Parbhoo and Fourie, 2017; Potnis et al., 2017). Our findings suggest that participating institutions mainly invest in AT that generate fundamental benefits (e.g. communication, mobility) for students with disabilities, rather than those assistive technologies that strengthen students' information literacy and help them complete academic tasks – the two benefits that most influence the intention of students with disabilities to use the technologies.

Hernon and Calvert (2006) present multiple instances when academic libraries underserve students with disabilities, and the authors recommend that libraries provide more patron-centric information services to students with disabilities. Potnis and Mallary (2021b) propose an information value chain, which views assistive technologies as conduits for transforming information into value for students with disabilities. To make the most informed decisions regarding investments, academic libraries must be aware of the diverse information needs of students with disabilities (Potnis and Mallary, 2021a). If academic libraries understand how and why students with disabilities use assistive technologies for accessing and using information services, they can make cost-effective decisions (Yeh and Walter, 2017).

Features of technologies used to deliver information services can influence students' intention to use them (Parbhoo and Fourie, 2017). Therefore, when investing in assistive technologies that support information literacy

and the completion of academic tasks, academic libraries must consider the user-friendliness of selected interfaces. A lack of user-friendly interfaces can frustrate librarians responsible for serving students with disabilities and discourage those students from using the technologies (Potnis and Mallary, 2021a).

To create value for students with disabilities, academic library administrators and staff members who responded to our qualitative survey envision developing user-centric information services. They establish an information environment grounded in principles of Universal Design. The purpose of Universal Design is to meet the needs of all patrons, regardless of their different abilities (Copeland, 2011). To make information fully accessible to patrons, Booth (2013) recommends that academic libraries embrace Universal Design: 'Vast expertise is not necessary to dismantle barriers to access; the first step is cultivating Universal Design habits of mind, such as consistency, flexibility, and simplicity' (p. 43). If academic libraries understand the full range of benefits of assistive technologies and adapt their efforts accordingly, their students with disabilities can receive more value-centric information services.

Alternatives to assistive technologies for creating value

This study does not aim to advocate for technology determinism (Frennert, 2021). For instance, although assistive technologies may be helpful, they are not the only solutions for students with disabilities navigating the value pyramid (Greenhalgh et al., 2012). Alternatives to assistive technologies, like personal care assistance and Universal Design for Learning (UDL) practices, can help potentially reduce learners' dependence on AT while enhancing their autonomy. Universal design proactively removes barriers to learning so that all students, regardless of their lived experiences, preferences for receiving and processing information, and techniques used to demonstrate their knowledge and skills, can receive an equitable education (CAST, 2018).

To reduce their dependence on assistive technologies, students with disabilities might utilise personal care assistants such as tutors, learning assistants, learning specialists, or academic coaches to communicate with others, physically navigate their campuses, complete academic tasks, build information literacy, and foster their autonomy and selves. Personal care assistants may help students with disabilities communicate with faculty members and peers during classes (West, 2019). Navigating their campuses can be easier for learners in a disability community who receive personal care assistance (Minotti et al., 2021). Assistants may facilitate students' completion of academic tasks, such as comprehending readings, transcribing notes, and sharing ideas aloud (O'Neill et al., 2012). Educating clients about innovative, evidence-based practices also help them build valuable information literacy skills for making everyday decisions (McCloskey, 2022). Students with disabilities may depend on this service in the short term (Olsen et al., 2020). Yet, people rely less on assistance and become more autonomous over time as they acquire lifelong skills, make informed decisions, and build self-esteem (Graby, 2018). Although personal care assistants may afford long-term benefits (e.g. information literacy, autonomy) to students with disabilities, using this service regularly is costly (Hannam-Swain, 2018). Hence, learners who cannot afford private services, or are not freely provided personal care assistance through their institutions, may not realise their autonomy.

Faculty members and academic librarians in higher education can help learners navigate the value pyramid (e.g. academic tasks, information literacy, autonomy) and limit students' dependence on assistive technologies by implementing Universal Design for Learning practices. For example, instructors who embrace Universal Design provide materials in alternative formats (e.g. accessible documents, electronic textbooks, interactive study guides) so their students with disabilities can equitably receive information and complete academic tasks without relying on assistive technologies (Moore, 2019). Additionally, librarians who train students to locate accessible resources and

critically evaluate and apply information help them build information literacy without requiring assistive technologies (Matamoros, 2018). Mastering information literacy skills are associated with learners' ability to solve everyday problems and become autonomous (Dubnjakovic, 2018). Furthermore, instructors who allow their students to use creative media (e.g. artwork, podcasts, videos) for showcasing knowledge and skills – as opposed to requiring that students complete formal examinations, PowerPoint presentations, and papers – enhance learners' autonomy, self-efficacy, and self-esteem, all while reducing the need for assistive technologies (Meyer et al., 2014). Although Universal Design benefits learners, particularly those with disabilities, implementing the practices requires faculty members and academic librarians to transform their attitudes toward students (Thompson and Copeland, 2020). Expecting those involved to change their attitudes is a tricky proposition since instructors and librarians might be unprepared, and perhaps unwilling, to include students with disabilities, whose accommodations are sometimes perceived as disadvantageous to learners without disabilities (Potnis and Mallary, 2021a, 2021b; Sarrett, 2018). Ultimately, students with disabilities who do not benefit from Universal Design for Learning may not attain autonomy.

Informing practice

None of the instruments (e.g. ATDPA, CHART, DAS 2.0, ETPA, PHQ) used by clinical practitioners for assessing the attitudes, motivations, and behaviours of people with disabilities surrounding AT consider their access to and use of information. We inform these instruments by developing the following information literacy indicators:

- Alternative formats: assistive technologies can help students with disabilities receive information in alternative formats (e.g. large-print books, audiobooks, video captioning) as necessary

- Search: assistive technologies can help students with disabilities search for

information (e.g. Google, library databases) as necessary

- Process: assistive technologies can help disabled students highlight, copy, and paste information or take notes as necessary

- Comprehend: assistive technologies can help students with disabilities comprehend information as necessary

- Evaluate: assistive technologies can help students with disabilities evaluate the usefulness of information as necessary

Conclusion, limitations, and future research

Past research emphasises the individual-level benefits that library patrons with disabilities derive from using assistive technologies. Our study advances this body of knowledge by revealing multiple organisational and social benefits that can be realised when academic libraries provide the technologies. Thus, the organisational context in which assistive technologies are offered and used influences the adoption of the tools. Assistive technologies are more than hardware and software; they allow academic libraries to champion institutional diversity, equity, and inclusion initiatives by delivering information services to vulnerable patrons. Findings indicate that students with disabilities can guide academic libraries' efforts in evaluating, selecting, and investing in assistive technologies, thus co-creating invaluable information services. However, the unrealised benefits of the technologies indicate a blind spot for providers who deliver information services to students with disabilities. Academic libraries need to address this weakness and identify additional blind spots when providing technologies other than assistive technologies.

Limitations

Information services' ability to create value for patrons varies according to the population (Potnis and Mallary, 2021b). Almost three-quarters of respondents to our quantitative survey are female. Male students' expectations

of assistive technologies may differ, and hence, the types of benefits that influence their intention to use the technologies may also vary. Academic libraries should be aware of this limitation before making specific investments in the technologies. Additionally, because we sampled libraries in public universities, our study's findings are not generalisable to every academic library in the US. The low response rate of our qualitative survey with librarians and library administrators may not represent all academic libraries that provide assistive technologies to students with disabilities. However, our conclusions can enhance educational institutions' understanding of the value of the technologies for both information service providers and patrons with disabilities.

Future research
Future investigations need to quantitatively examine the role of three organisational and three societal benefits in influencing librarians' intention to deliver information services through assistive technologies. Organisational benefits include (a) serving students with disabilities as an organisational strategy, (b) building community in academic institutions, and (c) enhancing the quality of information services offered by academic libraries. Diversity and equity, inclusion, and legal compliance represent societal benefits (see Table 1 above). Additional empirical studies with students with disabilities and libraries in colleges, and primary and secondary schools, can enrich our understanding of the benefits of assistive technologies. Information services offered in academic, college, and school libraries can then be compared to understand how strategically investing in the technologies can help enhance the autonomy and selves of patrons with disabilities.

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Appendix

What is your gender?

- Male
- Female
- Other
- Prefer not to answer

What is your current year in school?

- Freshman
- Sophomore
- Junior
- Senior
- Graduate student

Please select all the disabilities that apply to you:

- Attention deficit disorder (ADD)/attention deficit hyperactivity disorder (ADHD)
- Autism
- Depression/anxiety
- Dyslexia
- Hearing loss/deafness
- Mobility impairment
- Post-traumatic stress disorder (PTSD)
- Speech impairment
- Traumatic brain injury (TBI)
- Visual impairment/blindness
- Other

Now, let's think about how assistive technologies (AT) provided by your university can benefit disabled students.

An assistive technology refers to ". . . any item, piece of equipment, software program, or product system that is used to increase, maintain, or improve the functional capabilities of persons with disabilities" (Assistive Technology Industry Association, 2020).

Examples of AT include:

- Screen reading software (e.g. JAWS, Kurzweil)
- Magnification software (e.g. CCTV, ZoomText)
- Large-print books
- Captioning services
- Audio books
- Hearing aids or cochlear implants
- Reading and writing software (e.g. Read & Write Gold)
- Speech-to-text software (e.g. Dragon Naturally Speaking)
- Large monitors
- Adaptive keyboards or joysticks
- Adjustable workstations

- Automatic door openers

I.   Communication and Mobility

Rate your agreement [1 = Strongly Disagree; 5 = Strongly Agree] with the following statements:

- AT provided by my university can help disabled students physically move as necessary
- AT provided by my university can help disabled students see or hear as necessary
- AT provided by my university can help disabled students orally communicate as necessary
- AT provided by my university can help disabled students communicate through writing as necessary
- AT provided by my university can help disabled students navigate campus as necessary

II.   Information Literacy

Rate your agreement [1 = Strongly Disagree; 5 = Strongly Agree] with the following statements:

- AT provided by my university can help disabled students receive information in alternative formats (e.g. large-print books, audiobooks, video captioning) as necessary
- AT provided by my university can help disabled students search for information (e.g. Google, library databases) as necessary
- AT provided by my university can help disabled students highlight, copy, and paste information or take notes as necessary
- AT provided by my university can help disabled students comprehend information as necessary
- AT provided by my university can help disabled students evaluate the usefulness of information as necessary

III.   Completing Academic Tasks

Rate your agreement [1 = Strongly Disagree; 5 = Strongly Agree] with the following statements:

- AT provided by my university can help disabled students take notes during classes as necessary
- AT provided by my university can help disabled students complete assignments as necessary
- AT provided by my university can help disabled students take examinations as necessary
- AT provided by my university can help disabled students collaborate with peers as necessary

IV.   Improving Self

Rate your agreement [1 = Strongly Disagree; 5 = Strongly Agree] with the following statements:

- AT provided by my university can help disabled students improve self-esteem (i.e., individual's respect for him- or herself)
- AT provided by my university can help disabled students improve self-efficacy (i.e., individual's confidence in his or her abilities)
- AT provided by my university can help disabled students improve self-image (i.e., individual's perceptions of his or her appearance and personality)

V.   Autonomy

Rate your agreement [1 = Strongly Disagree; 5 = Strongly Agree] with the following statements:

- AT provided by my university can help disabled students participate in social gatherings

- AT provided by my university can help disabled students learn at a comfortable pace
- AT provided by my university can help disabled students improve their quality of life
- AT provided by my university can help disabled students exploit career opportunities

Let's see whether you plan to use AT provided by your university.

Rate your intent to use AT provided by your university [1 = Strongly Disagree; 5 = Strongly Agree]:

- I intend to use the AT provided by my university in the near future.
- I plan to use the AT offered by my university.
- I predict that I would adopt AT provided by my university.
- I expect to adopt AT provided
- by my university in the near future.