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Scoping Review - Physical Accessibility & Post-secondary Education

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A Scoping Review of the Physical Accessibility of Post-Secondary Schools for Individuals with Mobility Impairments

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Background:
Statistics Canada (2006) reports mobility impairments account for the largest proportion of disabilities experienced by students. Although accessibility standards exist for the physical design of built environments, universities and colleges are frequently cited as inaccessible. It is imperative to determine physical accessibility as research shows that successful involvement in post-secondary education leads to a more productive life and improved vocational options (Christ & Stodden, 2005). The International Classification of Functioning, Disability and Health (ICF) can provide a useful framework to categorize the barriers and facilitators to physical accessibility that affect participation in education.

Purpose:
The aim of this research was to examine the evidence on the physical accessibility of post-secondary schools for students with mobility impairments and provide an overview of the barriers and facilitators.

Methods:
A scoping review was conducted to determine the breadth and depth of the evidence available. The primary search terms were "accessibility", "school" and "mobility impairment." Only sources written in English after 1990 were included, as the first major accessibility legislation was enacted in 1990, the Americans with Disabilities Act. The databases searched were OvidMedline, CINAHL, Pubmed, Scopus, ProQuest, CBCA Education, ERIC, Engineering Village, PyscInfo, SocINDEX, and Google. Following a systematic screen of title, abstract and full-text relevancy, 49 articles were included for review. The ICF categories of Products and Technology and Natural Environment and Human-Made Changes to Environments were used to organize data extraction. Frequency of cited barriers and facilitators within these categories were recorded and presented in chart and paragraph form.

Findings:
The literature demonstrated that most barriers fell in the ICF categories of Design, Construction and Building Products and Technology for Gaining Access to Facilities Inside Buildings for Public Use (n=83) and Design, Construction and Building Products and Technology for Entering and Exiting Buildings for Public Use (n=56). These categories also presented the most facilitators (n=67 and n=37, respectively). Other barriers and facilitators were related to Products and Technology for Personal Indoor and Outdoor Mobility and Transportation; Products and Technology for Way Finding, Path Routing and Designation of Locations in Buildings for Public Use; Products and Technology for Gaining Access to Facilities in Buildings for Private Use; Products and Technology of Urban Land Development; Land Forms; Population Density; and Precipitation.

Implications:
Barriers to accessibility pose substantial problems, as barriers were mentioned more frequently than facilitators. To overcome barriers, the necessary changes required expensive architectural adaptations, such as installing elevators. Conversely, facilitators required less costly modifications, such as enlarging designated parking spaces. This research, combined with knowledge of accessibility legislation and human functioning, can help to support participation and raise awareness of occupational injustices related to accessing education. Future research could help determine funding and resource allocation priorities for constructing accessible environments. Future directions for stakeholders should include enforcing accessibility legislation, engaging in knowledge translation, and advocating for disability rights. Limitations of the study were exclusion of visual and hearing impairments, exclusion of non-English literature, possibility of overlooking search terms used in other countries, and not assessing the quality of the literature.

Background

Between the years of 1978 and 1994, the number of full-time students with disabilities attending colleges and universities in the United States tripled and this number is expected to continue to rise (Christ & Stodden, 2005). A 2013 report for the Higher Education Quality Council of Ontario (McCloy & DeClou) found that between 10 to 15% of students attending post-secondary institutions identified themselves as having a disability. Disability services offices in Canada and the United States also consistently report that the numbers of students who require accommodations is increasing (Harrison & Wolforth, 2012). In Canada, mobility impairments account for the largest proportion of disabilities experienced by students (Statistics Canada, 2006).

Accessibility is defined as the extent to which a product, service or environment is available to as many people as possible (Ansley, 2000). Despite enactment of accessibility legislation that addresses the built environment in the United States, Britain, and Ontario, Canada, colleges and universities, even in these geographical areas, continue to be identified as places that may be challenging to navigate if one has a mobility impairment (National Education Association of Disabled Students, n.d.). One study found that 24 percent of participants reported schools as a destination they would like to access, but often could not (Meyers, Anderson, Miller, Shipp & Helen, 2002), and an earlier study identified significant barriers to access amongst Canadian universities, particularly smaller institutions (Hill, 1992).

In North America, education is a productive occupation that is highly valued by society. Occupations are defined as groups of daily activities that individuals engage in to bring meaning to their life. Productive occupations are the contributions made to the social and economic fabric of communities (Canadian Association of Occupational Therapy, 2002). The importance of

education both as a productive occupation and as a conduit for enabling productive occupations in North America is evident through compulsory schooling starting at a young age. The Ontario Education Act states that "every person who attains the age of six… shall attend an elementary or secondary school on every school day… until the person attains the age of 18 years" (Service Ontario, 1990). Although education is not mandatory in Ontario beyond the age of 18, a significant proportion of the population pursues further studies. Eight percent of the population continues into trade certification or apprenticeship educations, while 22 percent are involved in college diploma or certification programs, and 29 percent attend university programs (Norrie & Lin, 2009). Participation in education contributes to the formation of identities and roles, gives meaning to life, provides structure and routines and contributes to the development of unique human beings (Polatajko et al., 2004). In addition, education helps to build dignity and worth in individuals, promotes social interactions, and increases quality of life, health and well-being (Townsend & Polatajko, 2007).

The experiences of students with mobility impairments attending post-secondary institutions can be significantly influenced by the degree to which the students can access the physical environment. The most commonly cited factor limiting participation in education is a lack of access, which can result from restrictions in the physical environment within facilities, among other factors (Stodden, Whelley, Chang & Harding, 2011). Limitations in access to education can subsequently lead to limited opportunities for involvement in the workforce, including the ability to obtain and maintain employment (Stodden et al., 2011). In Canada, only 53.6 percent of individuals with mobility impairments are full-time workers, compared to 75 percent of individuals without disabilities (Statistics Canada, 2006). The unemployment rate of individuals with mobility impairments is one of the highest, as categorized by disability type, at

12.1 percent (Statistics Canada, 2006). Obtaining post-secondary education is extremely important for those with disabilities, as there is strong evidence that access to and completion of higher education contributes to a more productive and satisfying life, greater financial success and improved vocational opportunities (Brown & Herbert Emery, 2010; Christ & Stodden, 2005; National Council on Disability, 2003).

In an attempt to increase the number of individuals who can access public buildings, governments from around the world have legislated standards for accessibility. The purpose of these standards is to identify, remove, and prevent barriers for individuals with physical disabilities, and to set guidelines for the construction and alteration of public and commercial facilities. These standards have been created in an effort to reduce the number of individuals who are unable to participate in society because of their disability (Department of Justice, 1990; Legislation Government UK, 1995; Ontario Ministry of Economic Development, Trade and Employment, 2005).

The Americans with Disabilities Act (ADA) came into force on July 1990 and focuses on striving to provide equal opportunities for individuals with disabilities in regards to employment, public accommodations, transportation, government services, telecommunications, and miscellaneous provisions. More recently, in 2010, the ADA released the Americans with Disabilities Act Standards for Accessible Design, which describes specific technical guidelines that must be followed when designing, and constructing new facilities or altering existing facilities (Department of Justice, 2010). There are components of these guidelines that are focused specifically on educational facilities (Department of Justice, 1990).

The Disability Discrimination Act (DDA) was enacted by the British government in 1995 in an attempt to promote civil rights for people with disabilities and to protect them from

discrimination within public environments. The DDA specifically focuses on ensuring the rights of persons with disabilities in regards to employment, education, access to goods, facilities and services, buying or renting land, and functions of public bodies. Specific to education, the DDA restricts education providers from discriminating against pupils with disabilities and ensures people with disabilities are not disadvantaged in educational institutions (Legislation Government UK, 1995).

There are no federal laws in Canada specifically related to accessibility; however, there are four statutes, The Canadian Human Rights Act, the Charter of Rights and Freedoms, the Canada Pension Act and the Economic Equity Act which focus on human rights and equity. These statutes also provide mechanisms for recourses to deal with inequities; however, none focus explicitly on enhancing accessibility for individuals with disabilities (McColl, Schaub, Sampson & Hong, 2010).

Ontario was the first province to initiate accessibility legislation at a provincial level with the Ontarians with Disabilities Act (ODA), enacted in 2001. The purpose of the ODA was to improve opportunities for individuals with disabilities by removing and preventing barriers to allow full participation in society (Service Ontario, 2001). However, the Act provided no standards to improve accessibility, nor for enforcing non-compliance (Accessibility for Ontarians with Disabilities Act Alliance, 2014). To further enhance accessibility, Ontario created the Accessibility for Ontarians with Disabilities Act (AODA) which was enacted in June 2005. This act stipulates mandatory accessibility standards for all public, private, government, and non-profit organizations in Ontario, Canada in five areas: customer service, information and communication, employment, transportation, and design of public spaces (e.g., outdoor play and picnic areas, paths, trails, curbs, ramps, parking spaces, and public service related elements such

as counters). In addition, standards for the built environment are now being incorporated into the Ontario Building Code (Ontario Ministry of Economic Development, Trade and Employment, 2013). The timeline to ensure compliance with these standards is being phased in depending on the type of organization, and can extend into 2017. There are currently no specific deadlines to ensure construction has been undertaken to improve accessibility (Ministry of Economic Development, Trade and Employment, 2013).

Manitoba has also now introduced legislation aimed at moving forward to reach the goal of being fully accessible. The Accessibility for Manitobans Act was given its first reading in the Manitoba legislature on April 24, 2013. The legislation's purpose is to remove barriers and create proactive, long-term plans that enhance accessibility for all within public environments (Manitoba Disabilities Issue Office, 2013). No further accessibility legislation exists within the provinces of Canada however, effective as of November 2013, Nova Scotia has begun advocating for the creation of a Nova Scotians with Disabilities Act (Accessibility for Ontarians with Disabilities Act Alliance, 2013).

Research Objective

The aim of this paper was to conduct a scoping review to map available evidence on the accessibility of post-secondary institutions for individuals with mobility impairments. The objectives were to provide an overview of the barriers and facilitators to the physical accessibility of post-secondary institutions, existing accessibility standards and the compliance to these standards. In addition, we strived to highlight gaps in the literature for the purposes of increasing awareness of how post-secondary institutions can be made more accessible.

Levac, Colquhoun, and O'Brien (2010) endorse proposing a research question that focuses on a target population related to a specific outcome, rather than using a broad,

unspecified question when designing scoping reviews. To align with these recommendations, we developed the following question: "What is known in the existing literature about the nature of physical accessibility in post-secondary schools for individuals with mobility impairments?"

Scope of Interest

The population of interest was individuals with mobility impairments who attend, or have attended, a post-secondary institution. Mobility impairment, as adapted from the AODA's operational definition of disability, is any degree of disability, infirmity, malformation or disfigurement that results in difficulties navigating the physical environment (Ontario Ministry of Economic Development, Trade and Employment, 2005).

Levac et al. (2010) state that when limiting the scope of a topic is unavoidable, decisions for exclusion need to be both justified and acknowledged. To follow these recommendations, we recognized that we had limited resources available for this scoping review and were therefore unable to focus on the specialized needs for physical accessibility of individuals with visual and hearing impairments, nor were we able to search literature written in languages other than English. We were specifically concerned with the accessibility of post-secondary institutions, defined as facilities that provide education beyond high school that are both degree-granting and non-degree granting. These may include colleges, universities, university colleges, institutes of technology and specialized institutions (Canadian Information Center for International Credentials, 1990).

Study Design

A scoping review is a form of in-depth literature review that aims to describe the important concepts of a particular topic and to determine the types of sources and evidence available. In addition, scoping reviews can be used to identify gaps in the available research

literature (Arskey & O'Malley, 2003) and are often iterative in nature, requiring revisions in terminology and criteria as evidence emerges (Levac et al., 2010). As a research group, we determined that a scoping review was the most appropriate method for our topic, due to the challenges that arose during our preliminary search, including:

1. Only a limited number of peer-reviewed journal articles were found specific to the accessibility of post-secondary institutions for individuals with mobility impairments. In addition, very few of the articles constituted studies and even fewer were randomized controlled trials. Thus, it would not be fruitful to evaluate the quality of resources available, as almost none would meet quality criteria for research (Consort, 2010).
2. The majority of literature on physical accessibility is currently unpublished due to the recent emergence and consistently changing accessibility legislation, such as the ODA in 2001and the AODA in 2005. Therefore, it was important to search grey literature in order to try to capture the current breadth and scope of knowledge.

To guide our research process, we followed Arskey and O'Malley's (2003) methodological framework for conducting a scoping review, which outlines five critical stages:

1. Identifying the research question
2. Identifying relevant studies
3. Study selection
4. Charting the data
5. Collating, summarizing, and reporting the results

While this framework provides a foundation for scoping review methodology, it does not provide sufficient detail to ensure consistent use by researchers. Levac et al., (2010) expand on Arskey and O'Malley's (2003) stages and provide additional clarification and recommendations to

enhance the presentation of a scoping review. Specific recommendations provided by Levac et al. (2010) have been incorporated into our methodological design and are highlighted throughout each section of this report.

Identifying Relevant Studies

Both qualitative and quantitative peer-reviewed studies were included in this research. Grey literature was also included in order to achieve a comprehensive coverage of available information. Grey literature is literature that is produced by all levels of government, academics business and industry, but is considered unpublished as it is not controlled by commercial publishers and does not appear in journals and/or peer reviewed publications (Alberani, Pietrangeli & Mazza, 1990). We used a multidisciplinary approach when identifying relevant studies. Databases were searched from health sciences, education, engineering, and social sciences. The specific databases and search engines used are presented in Table 1.

Table 1: Databases and Search Engines

Health Sciences	Education	Engineering	Social Sciences	Grey Literature
Ovid Medline CINAHL PubMed Scopus	ProQuest ERIC CBCA Education	Engineering Village	PsychInfo SocINDEX	Google

As recommended by Levac et al. (2010), during the preliminary stages of our study we utilized an iterative approach, in which the research focus and search terms continuously changed and evolved. Our initial research objective focused on the accessibility of post-secondary institutions for individuals with physical disabilities specific to Canada, but the available evidence was limited. We proceeded by expanding our search terms to include all buildings within the public domain, but were overwhelmed with the quantity of literature available on such a broad topic. After multiple group deliberations, it was decided that the focus

of our research topic would be the accessibility of post-secondary schools throughout the world for individuals with mobility impairments.

Throughout the process of gathering relevant evidence, we used three primary search terms, “accessibility”, “school”, and “mobility impairment”. The grey literature search used only the three primary search terms and we ceased our Google search once ten irrelevant titles appeared. An irrelevant title was any title that did not contain our three primary search terms.

For the database searches, we used all three primary search terms and their synonyms. Specific search terms can be found in Table 2. Where possible, we used a building block search strategy, in which the search terms were searched individually then combined systematically through the use of Boolean operators. The building block strategy used was (accessibility OR barrier free design OR universal design OR inclusive environment OR physical access OR architecture) AND (school OR post secondary OR college OR university OR education OR campus) AND (mobility impairment OR physical disability OR gait disturbance OR walking impairment OR wheelchair OR handicap OR disabled). In addition, we engaged in a manual search of references to produce the greatest breadth of information.

Table 2: Search Terms

Accessibility	**School**	**Mobility Impairment**
Barrier-free design	Post-secondary	Physical disability
Universal design	University	Gait disturbance
Inclusive environment	College	Walking impairment
Physical access	Education	Wheelchair
Architecture	Campus	Handicap
		Disabled

When possible, the searches were limited to literature published in the English language, after the year 1990, and pertaining to humans. Literature published in foreign languages was excluded due to the cost and time involved in translating material. Literature published before 1990 was excluded as that was the year the ADA, one of the first accessibility acts to be

implemented, came into effect. We were interested in examining the literature regarding physical accessibility of post-secondary institutions that has been written since accessibility legislation came into effect.

Study Selection

After conducting our literature search, results were electronically exported and stored in Refworks©. At this point, all duplicate articles were deleted, using an exact duplicate removal process (Shaw, 2013). All the remaining articles were uploaded to Distiller SR©, an online system designed for use during systematic reviews to complete the screening phases. The title screen, abstract screen and full-text relevancy assessment were completed using Distiller SR© forms.

Appendix A outlines the inclusion and exclusion criteria that was used to determine relevance based on title. As Levac et al. (2010) suggested, two reviewers applied the inclusion and exclusion criteria to all article titles and independently determined if the article titles were relevant to our research question. Inter-rater reliability was manually tracked using a tally system, in which the researchers documented a tally mark for each time a disagreement occurred regarding relevance. The number of disagreements were summed and subtracted from the total number of included sources to determine the number of agreements. The number of agreements was then divided by the total number of sources to calculate the inter-rater reliability statistic. As Levac et al. (2010) suggested, discrepancies were resolved by a third researcher who applied the inclusion and exclusion criteria to screen the title.

Appendix B outlines the inclusion and exclusion criteria that were used to determine relevance based on abstract. In this process, the literature was divided in half, with each half assigned to a group of two reviewers. Inter-rater reliability was manually tracked using a tally

system as described above. When it was difficult to confirm an article's eligibility, all reviewers accessed the full-text to determine relevance (Shaw, 2013).

Once the literature was narrowed by title and abstract, the full-text was obtained and each article was fully read and evaluated against a predetermined relevancy scale. Appendix C outlines the relevancy scale that was used when assessing articles. The scale ranged from one to five, with five being the most relevant articles to our research question. At this stage, a trial relevancy rating was conducted, in which four randomly selected articles were read and rated by each group member. The purpose of this trial stage was to ensure inter-rater accuracy when scoring articles based on relevance. Upon completion of the trial stage, the articles were divided equally among group members and given a relevancy rating. Parallel to suggestions from Levac et al. (2010), any article that an individual was unable to rate confidently was flagged for all group members to rate and inclusion was determined based on group consensus. Articles that scored a three, four or five were included in the review. Following completion of the full-text relevancy rating, a manual search of reference lists was conducted.

Charting the Data

The final 49 included sources were uploaded to DropBox© and each researcher was randomly assigned 12 or 13 articles to complete the data extraction process. To guide our data extraction, a Google Drive data extraction form was created collectively by all members of the research team, as suggested by Levac et al. (2010). The form described the specific variables to extract in order to answer our research question. See Appendix D for a blank data extraction form that illustrates the demographics and categories used.

Levac et al. (2010) also recommended using an iterative process when charting the data, in which the researchers continually extract information and update the data extraction form. To

follow these suggestions, our data extraction form was continuously altered and edited by all members of the research team to ensure adequate collection of data to answer our research question. After the data was extracted, an Excel document was created.

When reviewing the extracted data, it became apparent that organizing the data into coherent sets could not be accomplished without a clear model to follow. We therefore turned to the International Classification of Functioning, Disability and Health (ICF), which is an internationally accepted system of nomenclature describing human functioning and its restrictions (World Health Organization [WHO], 2001). The ICF contains a chapter on Environmental Factors which are described as the "physical, social, and attitudinal environment in which people live and conduct their lives" (WHO, 2001). When the ICF terminology for the physical environment was applied to the data, it proved a useful framework for categorizing the barriers and facilitators affecting participation in post-secondary schools as described in the literature included in this review.

The environmental component of the ICF encompasses products and technology, the natural environment and human-made changes to environments, support and relationships, attitudes, and services, systems and policies. The categories we used focused on products and technology and the natural environment and human-made changes to environments, as they relate specifically to physical accessibility. The nine sub-categories used to reorganize the data were:

1. General Products and Technology for Personal Indoor and Outdoor Mobility and Transportation (ICF Category- e1200).
2. Design, Construction and Building Products and Technology for Entering and Exiting Buildings for Public Use (ICF Category- e1500).

3. Design, Construction and Building Products and Technology for Gaining Access to Facilities Inside Buildings for Public Use (ICF Category- e1501).
4. Design, Construction and Building Products and Technology for Way Finding, Path Routing and Designation of Locations in Buildings for Public Use (ICF Category- e1502).
5. Design, Construction, and Building Products and Technology for Gaining Access to Facilities in Buildings for Private Use (ICF Category- e1551).
6. Products and Technology of Urban Land Development (ICF Category- e1602).
7. Land Forms (ICF Category- e2100).
8. Population Density (ICF Category- e2151).
9. Precipitation (ICF Category e2253).

See Appendix E for full descriptions of each category.

Collating, Summarizing, and Reporting the Results

The data extracted from the reviewed sources was reanalyzed and distributed into the ICF categories. The categories were then distributed equally among group members for collating, summarizing and reporting the results. Each member independently recorded the frequencies of key phrases and quotations related to the barriers and facilitators of physical accessibility in each respective category, in chart and paragraph form. This process was undertaken based on recommendations presented by Levac et al., (2010) that state an analysis should occur first, in which numerical summaries and thematic analyses are presented. To guide the process of determining whether a key phrase was a barrier or a facilitator, and to increase homogeneity of results, predetermined definitions of barriers and facilitators were created. The definitions used were adapted from the ICF in order to answer the overall scoping question regarding the physical

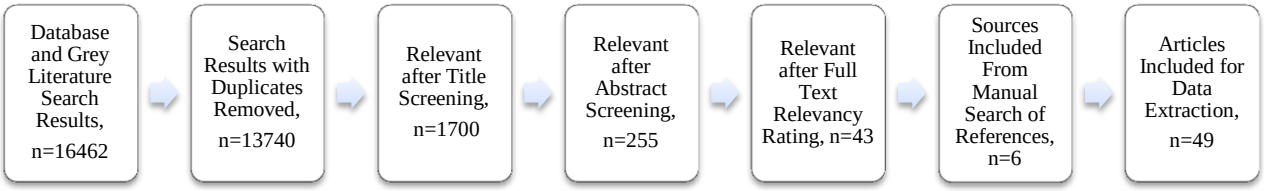
accessibility of post-secondary institutions. Facilitators were defined as factors in an individual's environment that, through their absence or presence, improve functioning and reduce disability (WHO, 2001). Furthermore, facilitators can prevent impairments, such as mobility limitations from becoming a participation restriction (WHO, 2001). For the purpose of this study, facilitators included characteristics such as accessible physical environments and the availability of relevant assistive technology that serves to increase the involvement of all individuals with mobility impairments. Conversely, barriers were defined as factors in an individual's environment that, through their absence or presence, limit functioning and promote disability (WHO, 2001).

The frequency statistics for barriers and facilitators were then discussed as a group and key themes that emerged in each category were vocalized and agreed upon. It was decided that barriers and facilitators to physical accessibility were to be reported separately, however, overlap existed in some instances. Some reviewed sources described a key entry as both a barrier and a facilitator and within one source there could be multiple barriers and facilitators mentioned. For example, one included source described the design of doors as a barrier due to the presence of heavy fire doors that make entering buildings more difficult, but the design of doors was also described in the context of a facilitator if automatic door openers were to be installed (O'Connor & Robinson, 1999). In this case, the design of doors would have been counted as both a barrier and a facilitator.

Findings

In total, 49 articles were included in our scoping review. Figure 1 below is a visual that describes the number of articles found at each stage of our search process.

Figure 1: Results of Systematic Search Process



Inter-rater reliability was calculated for both the title and abstract screen to determine the amount of homogeneity between group members. The inter-rater reliability was 92% for title screen and 94% for abstract screen.

See Appendix F for the data extraction table describing characteristics of all 49 articles retained for review.

The reviewed sources were authored in nine different countries. Of the 49 sources included, the countries that generated the most literature were the United States (n=23), United Kingdom (n=12) and Canada (n=8). The remaining sources originated from Malaysia (n=1), Ireland (n=1), South Africa (n=1), Cyprus (n=1), Kuwait (n=1), and China (n=1).

Only eight sources included in the scoping review were quantitative in nature; most sources were qualitative studies (n=25). Three sources used mixed methodological designs. In addition, many of the resources were found in scientific literature that was not considered primary research articles. Five sources were editorials, which are defined as articles that express the authors' point of view about a particular topic (The Undergraduate Science Librarian, n.d.). One source was a book series, which is defined as one individual chapter of a larger publication (The Undergraduate Science Librarian, n.d.). Three sources were technical reports, which are defined as publications that are released from government agencies and not-for-profit organizations in order to enhance science (The Undergraduate Science Librarian, n.d.). One source was classified as a review article, which is defined as a piece of literature that seeks to

synthesize and summarize the work of previous publications on a particular topic (The Undergraduate Science Librarian, n.d.). Three sources were unpublished doctoral dissertations, which are defined as the final products of research conducted by PhD and Master degree students, which has undergone exhaustive review by academic advisors, but is not considered peer-reviewed (The Undergraduate Science Librarian, n.d.).

ICF Category (e1200): General Products and Technology for Personal Indoor and Outdoor Mobility and Transportation

General products and technology for transportation was mentioned in 33% of the included sources (n=16) (see Appendix G). The barriers (n=10) identified in the reviewed sources were more numerous than the facilitators (n=8). The most frequently cited facilitator was an accessible mini-bus service (n=7) (Cooper, 2012; Dolce, 2007; Goode, 2007; Hebel, 2001; Kennedy, 2005; National Educational Association of Disabled Students [NEADS], 2010; Tiedemann, 2008). Campuses that included a dedicated accessible minibus service to transport students with mobility difficulties around and between sub-campuses were more accessible than those that did not offer this service (Goode, 2007). Community-based vehicle support was also mentioned (n=1) (Hill, 1992). Limited availability of accessible public transportation was the most frequently cited barrier to transportation within the physical environment (n=6) (Borland & James, 1999; Canadian Council on Learning, 2009; Russell & Demko, 2005; Salmon, 2011; Shevlin, Kenny & McNeela, 2004; Singh, 2003). Lack of awareness of available accessible transportation (n=1) (Cooper, 2012) and inaccessible transit stops (n=3) (Kennedy, 2005; Lane, Swartz & McNair, 1993; Wu, Gan, Cevallos & Hadi, 2011) were also barriers in the reviewed sources. One study in particular found that 49% of transit stops within a Florida university region were not ADA compliant, which limited the mobility of students with physical disabilities

(Wu et al., 2011). Non-compliance with ADA simply means that the transit stops in question were not adhering to the accessibility guidelines set out by the government of the United States in the Americans with Disabilities Act. Some common non-compliance issues presented by Wu et al. (2011) included sidewalk widths less than 3 feet, absence of curb cuts at the ends of sidewalks, and insufficient manoeuvring space on wheelchair loading pads.

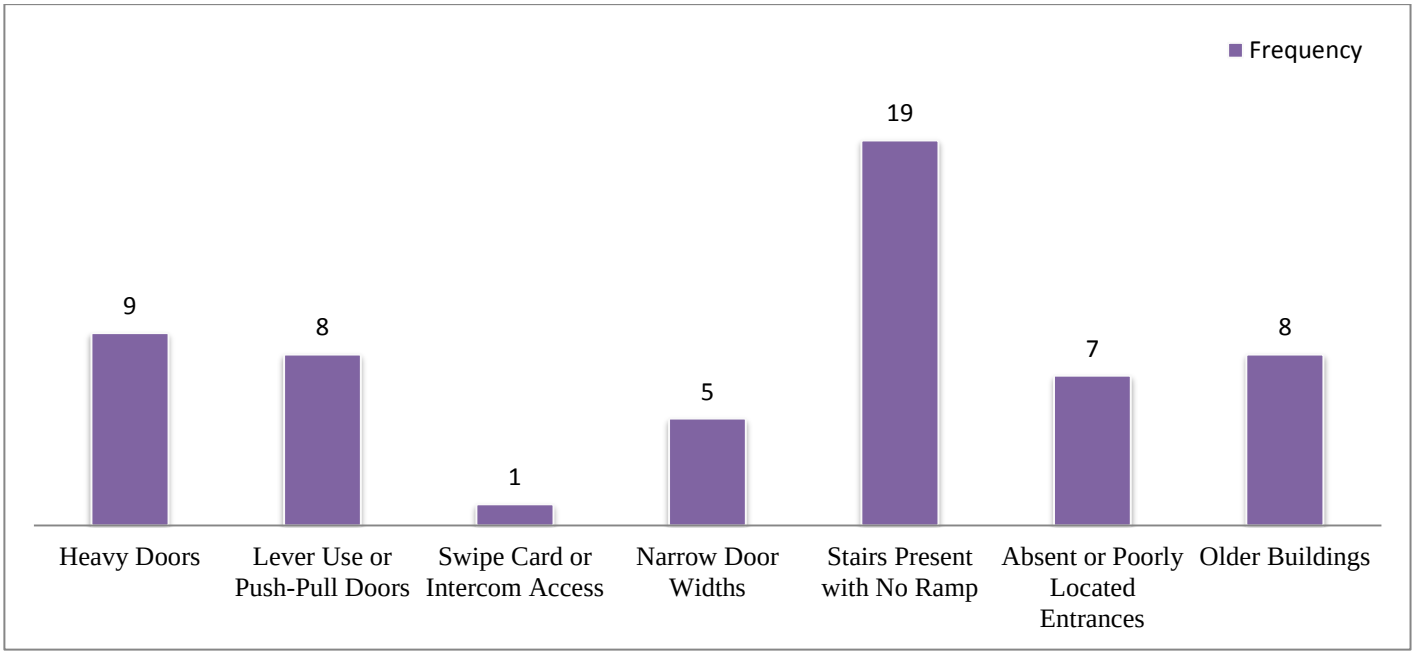
ICF Category (e1500): Design, Construction and Building Products and Technology for Entering and Exiting Buildings for Public Use

Products and technology for entering and exiting buildings was mentioned in 73% of the reviewed sources (n=36) (see Appendix H). The barriers (n=56) identified in the reviewed sources were more numerous than the facilitators (n=37). Three main categories were discussed with regards to product and technology facilitators for entering and exiting buildings: design of doors, design of ramps, and design of entrance locations. Facilitators that enhance physical accessibility with regards to the design of doors include the presence of automatic doors (n=12) (Chard & Couch, 1998; Cooper, 2012; Dolce, 2007; Gilson & Depoy, 2011; Hebel, 2001; Kennedy, 2000; Kennedy, 2005; Salmon, 2011; Samson, 2010; Smyser, 2003; Soorenian, 2004; Wernsman, 2008), undergoing construction to widen existing door frames (n= 3) (Kennedy, 2000; Nelson, 1996; Wernsman, 2008), and junctured entrances and exits, in which only one door is present to manoeuvre through (n=1) (Gilson & Depoy, 2011). Facilitators with regards to the design of ramps include entrances with even entry that do not require stairs or ramps (n=1) (Gilbert, 2013), the presence of platform lifts when ramps are unfeasible (n=1) (Kennedy, 2005), and the presence of ramps at building entrances (n=10) (Gilbert, 2013; Hadjikakou, Polycarpou & Hadjilia, 2010; Hall & Tinklin, 1998; Kennedy, 2000; Kennedy, 2005; Lane et al., 1993; O'Connor & Robinson, 1999; Samson, 2010; Tinklin & Hall, 1999; Wernsman, 2008). The

construction of ramps to bypass steps and cut outs in curbing to allow wheelchair access is considered an absolute necessity to enable students to reach the doors of facilities (Lane et al., 1993). Facilitators, with regard to the design of entrance locations, include the presence of multiple accessible entrances (n=5) (Alrashidi, 2010; Kennedy, 2005; Lane et al., 1993; Salmon, 2011; Samson, 2010) and barrier-free pathways to entrances (n=4) (Adam et al., 2008; Alrashidi, 2010; Lane et al., 1993; Samson, 2010) Four main categories were discussed with regards to product and technology barriers for entering and exiting buildings: design of doors, design of ramps, design of entrance locations, and construction to undergo accessibility modifications. Figure 3 below depicts the specific barriers and the frequencies with which they were cited. Barriers to physical accessibility with regards to the design of doors include narrow door widths (n=5) (Adam et al., 2008; Alrashidi, 2010; Carpenter, 1996; Chard & Couch, 1998; Simonson, 2012), heavy doors (n=9) (Alrashidi, 2010; Chard & Couch, 1998; Gilson & Depoy, 2011; Lane et al., 1993; Murphy & Murphy, 1997; O'Connor & Robinson, 1999; Shevlin, Kenney & McNeela, 2004; Soorenian, 2013; Taylor, 2004), lever use or push-pull doors (n=8) (Carpenter, 1996; Chard & Couch, 1998; Hill, 1992; Kennedy, 2000; Lane et al., 1993; Simonson, 2012; Singh; 2003; West et al., 1993), and swipe card or intercom access (n=1) (Chard & Couch, 1998). The only cited barrier to physical accessibility with regards to the design of ramps is the presence of stairs with no available ramp (n=19) (Adam et al., 2008; Alrashidi, 2010; Chard & Couch, 1998; Cooper, 2012; Gilson & Depoy, 2011; Hadjikakou, 2010; Hebel, 2011; Hill, 1992; Hopkins, 2011; Kennedy, 2000; Kennedy, 2005; Kim & Williams, 2012; Loinsky, Levi, Saffey & Jelsma, 2003; Murphy & Murphy, 1997; O'Connor & Robinson, 1999; Russell & Demko, 2005; Shevlin et al., 2004; Singh, 2003; Taylor, 2004). The sole barrier to physical accessibility with regards to the design of entrance locations is absent or poorly located entrances (n=7)

(Adam et al., 2008; Hall & Tinklin, 1998; Hebel, 2001; Pitt & Curtin, 2004; Simonson, 2012; Wernsman, 2008; West et al., 1993). Older buildings that cannot undergo construction for accessibility modifications was also cited as a barrier to physical accessibility (n=8) (Carpenter, 1996; Chard & Couch, 1998; Goode, 2007; Hadjikakou, 2010; Hall & Tinklin, 1998; Hill, 1992; US Department of Justice, 2009; West et al., 1993).

Figure 3: Frequency of Barriers for the Design, Construction and Building Products and Technology for Entering and Exiting Buildings for Public Use



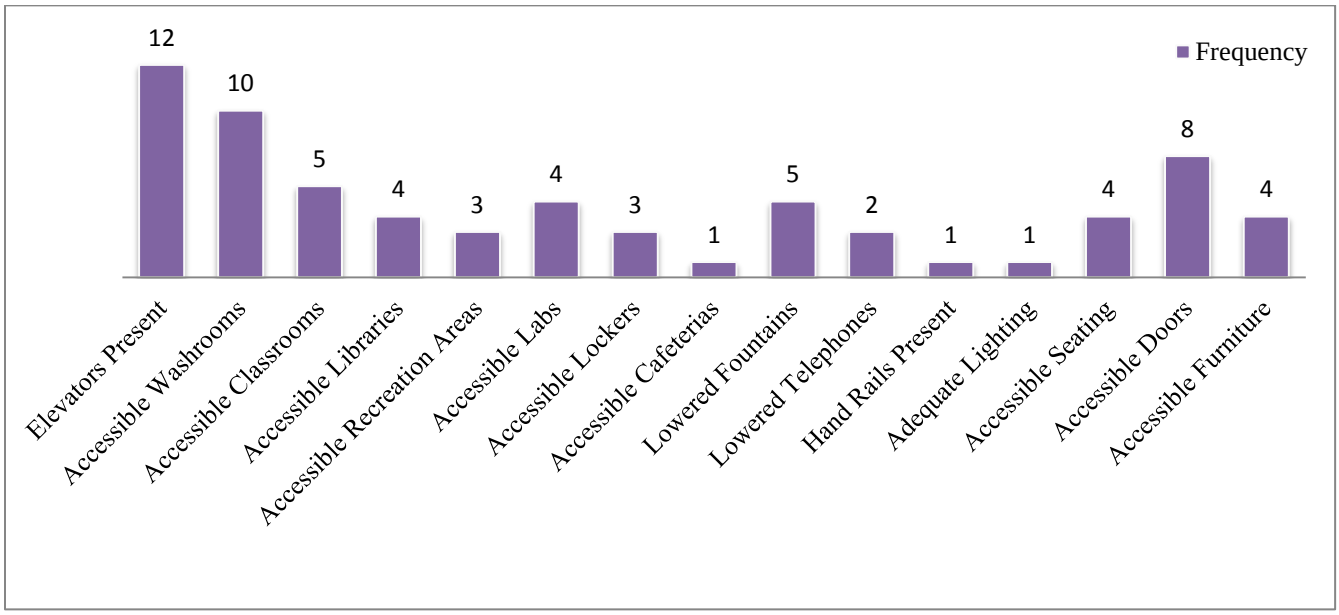
ICF Category (e1501): Design, Construction and Building Products and Technology for Gaining Access to Facilities Inside Buildings for Public Use

Barriers and facilitators for the design, construction and building products and technology for gaining access to facilities inside buildings for public use were represented in 78 percent of included sources (n=38) (see Appendix I). The barriers (n=83) identified in the reviewed sources were more numerous than the facilitators (n=67). The most frequently mentioned facilitator was the availability of elevators and lifts (n=12) (Alrashidi, 2010; Dolce, 2007; Gilbert, 2011; Hebel,

2001; Holloway, 2001; Kennedy, 2000; Kennedy, 2005; Lane, et al., 1993; NEADS, 2010; Nelson, 1996; Samson, 2010; Singh, 2003), particularly because elevators and lifts allow full participation and access to all facilities and amenities in multi-level buildings for students with disabilities (Lane et al., 1993). Other common facilitators were accessible rooms within campus buildings, including accessible washrooms (n=10) (Adam et al., 2008; Alrashidi, 2010; Chard & Couch, 1998; Dolce, 2007; Gilbert, 2013; Kennedy, 2000; Kennedy, 2005; NEADS, 2010; Salmon, 2011; Singh, 2003), accessible classrooms (n=5) (Adam et al., 2008; Alrashidi, 2010; Chard & Couch, 1998; NEADS, 2010; Singh, 2003), accessible libraries (n=4) (Adam et al., 2008; Alrashidi, 2010; Nelson, 1996; Samson, 2010), accessible recreation areas (n=3) (Cooper, 2012; Hebel, 2001; NEADS, 2010), accessible labs (n=4) (NEADS, 2010; Russell & Demko, 2005; Singh, 2003; Smyser, 2003), accessible locker rooms (n=3) (Dolce, 2007; NEADS, 2010; Salmon, 2010), and accessible cafeterias (n=1) (Singh, 2003). Simple modifications to existing amenities in campus buildings were also cited as facilitators to physical accessibility in relation to products and technology for gaining access to facilities inside buildings. Modifications included lowering drinking fountains (n=5) (Gilbert, 2013; Hebel, 2001; Kennedy, 2000; Lane et al., 1993; NEADS, 2010), lowering public telephones (n=2) (Singh, 2003; Hebel, 2001), installing hand rails in stairways (n=1) (Dolce, 2007) and ensuring adequate lighting in campus buildings (n=1) (Dolce, 2007). Other cited facilitators were accessible seating (n=4) (Alrashidi, 2010; NEADS, 2010; Ontario Undergraduate Student Alliance, 2012; Salmon, 2011), accessible doors (n=8) (Dolce, 2007; Holloway, 2001; Kennedy, 2000; Kennedy, 2005; Lane et al., 1993; NEADS, 2010; Samson, 2010, Smyser, 2003) and accessible furniture (n=4) (NEADS, 2010; Salmon, 2011; Samson, 2010; Smyser, 2003). One study in particular found that 87.5% of universities were equipped with accessible furniture, including adjustable computer tables,

accessible keyboards, accessible study desks and stand-up computer tables (Samson, 2010). Figure 4 below depicts all the facilitators in the reviewed sources.

Figure 4: Frequency of Facilitators for the Design, Construction and Building Products and Technology for Gaining Access to Facilities Inside Buildings for Public Use



The most frequently cited barrier restricting physical access within public buildings was the inadequate availability of elevators (n=15) (Adam et al., 2008; Alrashidi, 2010; Borland & James, 1999; Chard & Couch, 1998; Cooper, 2012; Hadjikakou et al., 2010; Hall & Tinklin, 1998; Kennedy, 2005; Murphy & Murphy, 1997; O'Connor & Robinson, 1999; Pitt & Curtin, 2004; Simonson, 2012; Tinklin & Hall, 1999; Wernsman, 2008; West et al., 1993). One study found that students often complained that there were no means available to access classrooms on upper levels and therefore classes had to be on the ground floor only. In addition, maintenance was a confounding issue, as students often reported being stranded on broken elevators and requiring assistance (Hadjikakou et al., 2010). Another cited barrier related to a lack of access to upper level classrooms was multi-level buildings (n=3) (Kennedy, 2005; O'Connor & Robinson, 1999; Pitt & Curtin, 2004), which are often more inaccessible than single storey facilities

(Kennedy, 2005). The presence of stairs in academic buildings was also cited as a barrier, limiting access to upper level classrooms (n=6) (Alrashidi, 2010; Borland & James, 1999; Chard & Couch, 1998; Kennedy, 2005; Murphy & Murphy, 1997; Russell & Demko, 2005). The second most commonly cited barrier was limited availability of accessible washrooms (n=12) (Barth, 2006; Borland & James, 1999; Chard & Couch, 1998; Cooper, 2012; Hadjikakou et al., 2010; Kennedy, 2000; Kennedy, 2005; Loinsky et a., 2003; O'Connor & Robinson, 1999; Pitt & Curtin, 2004; Russell & Demko, 2005; Simonson, 2012). Inaccessible rooms within campus buildings were also common barriers to physical accessibility and included inaccessible classrooms (n=9) (Alrashidi, 2010; Borland & James, 1999; Canadian Council on Learning, 2009; Cooper, 2012; Mohd-Nor et al., 2010; Pitt & Curtin, 2004; Shevlin et al., 2004; Simonson, 2012; West et al., 1993), inaccessible labs (n=3) (Alrashidi, 2010; Kennedy, 2005; West et al., 1993), inaccessible recreation areas (n=4) (Hebel, 2001; Kennedy, 2005; Mohd-Nor et al., 2010; Simonson, 2012), inaccessible cafeterias (n=1) (Wernsman, 2008), and inaccessible libraries (n=10) (Cooper, 2012; Hall & Tinklin, 1998; Kennedy, 2005; Kin & Williams, 2012; Murphy & Murphy, 1997; O'Connor & Robinson, 1999; Pitt & Curtin, 2004; Samson, 2010; Tinklin & Hall, 1999; West et al., 1993). Some commonly cited barriers within libraries were items located on shelves that were out of reach (Kim & Williams, 2012) and photocopy machines that were too high to use from a wheelchair (Murphy & Murphy, 1997). Other less commonly cited barriers include lack of rest areas in hallways (n=1) (Alrashidi, 2010), inaccessible seating (n=8) (Alrashidi, 2010; Borland & James, 1999; Goode, 2007; Hebel, 2001; Holloway, 2001; Hopkins, 2011; Murphy & Murphy, 1997; Shevlin et al., 2004), inaccessible lockers (n=1) (Chard & Couch, 1998), inaccessible doors (n=4) (Hall & Tinklin, 1998; Kennedy, 2005; Murphy & Murphy, 1997; Tinklin & Hall, 1999), inaccessible public telephones (n=3) (Hill, 1992;

Kennedy, 2000; Kennedy, 2005), and inaccessible drinking fountains (n=3) (Hill, 1992; Kennedy, 2000; Kennedy 2005).

ICF Category (e1502): Design, Construction and Building Products and Technology for Way Finding, Path Routing and Designation of Locations in Buildings for Public Use

Barriers and facilitators for way finding, path routing and designation of locations in buildings for public use were discussed in 35% of included sources (n=17) (see Appendix J). Barriers (n=15) were reported more frequently than facilitators (n=11) within the identified sources. The most frequently cited facilitators with regards to the design, construction and building products and technology for way finding was when accessible signage was present (n=3) (Alrashidi, 2010; Kennedy, 2005; Samson, 2010) and when pathways were clear from obstructions (n=3) (Alrashidi, 2010; Kennedy, 2000; Samson, 2010). In addition, the presence of inclusive campus maps that outline accessibility were noted to aid in the navigation of public spaces (n=3) (Goode, 2007; Kennedy, 2005; NEADS, 2010). Universities that provided maps containing a detailed breakdown of the buildings and classrooms that are fully or partially accessible for students with mobility impairments were viewed as more appealing to students with physical limitations (NEADS, 2010). Other facilitators include maps located in building lobbies for navigation (n=1) (Samson, 2010), as well as wide aisles (n=1) (Salmon, 2011).

The most frequently cited barrier was narrow hallways and paths within campus buildings (n=4) (Chard & Couch, 1998; Hadjikakou et al., 2010; Murphy & Murphy, 1997; Nelson, 1996), followed by a lack of campus maps that describe accessible routes (n=3) (Chard & Couch, 1998; Hopkins, 201; Kennedy, 2000), poor accessibility signage (n=3) (Alrashidi, 2010; Carpenter, 1996; Chard & Couch, 1998) and inadequate building maintenance (n=2) (Adam et al., 2008; Gilson & Depoy, 2011). Increased travel time on campus contributed to

inaccessibility issues (n=2) (Chard & Couch, 1998; Hall & Tinklin, 1998) and was described in one source as extremely tiring, as students with mobility impairments often had to take circuitous routes on campus to find pathways that are physically accessible (Hall & Tinklin, 1998). Narrow aisles (n=1) between library stacks was also identified in one source as a barrier to navigating campus buildings (Tinklin & Hall, 1999).

ICF Category (e1551): Design, Construction and Building Products and Technology for Gaining Access to Facilities in Buildings for Private Use

Products and technology for buildings for private use were mentioned in 35% of the included sources (n=17) (see Appendix K). The facilitators (n=24) identified in the reviewed sources were more numerous than the barriers (n=22). The most frequently cited facilitator was modified housing and dorm rooms (n=8) (Cooper, 2012; Goode, 2007; Kennedy, 2005; NEADS, 2010; Salmon, 2011; Soorenian, 2013; Tiedemann, 2008; Wernsman, 2008), especially when the accessible rooms were placed at the beginning of long corridors, radiating from the central core, and in close proximity to the elevator (Wernsman, 2007). Other facilitators include accessible washrooms (n=5) (Cooper, 2012; Kennedy, 2005; Salmon, 2011; Soorenian, 2013; Wernsman, 2008), modified laundry facilities (n=1) (Cooper, 2012), accessible dining halls (n=2) (Cooper, 2012; Salmon, 2011), accessible furniture design (n=2) (Gilbert, 2013; Wernsman, 2008), reserved spaces in residences for individuals with physical disabilities (n=2) (NEADS, 2010; Soorenian, 2013), and accessible fire exits (n=3) (Chard & Couch, 1998; Cooper, 2012; Tiedemann, 2008). Technology was also considered a facilitator for physical accessibility (n=1) (Gilbert, 2013) and focused specifically on the use of a new WiFi system that will allow wheelchair users to unlock their room door as they approach it (Gilbert, 2013). Barriers mentioned in the reviewed sources include inaccessible dorm rooms (n=7) (Hopkins, 2011;

Kennedy, 2005; Russell & Demko, 2005; Simonson, 2012; Singh, 2003; Soorenian, 2013; West et al., 1993), poor furniture design (n=3) (Barth, 2006; Gilson & Depoy, 2011; Soorenian, 2013), poor furniture placement (n=1) (Gilson & Depoy, 2011), inaccessible washrooms (n=4) (Cooper, 2012; Gilson & Depoy, 2011; Simonson, 2012; Singh, 2003), and narrow hallways in dorm rooms (n=2) (Chard & Couch, 1998; Soorenian, 2013). Inappropriate dining halls was also considered a barrier to physical accessibility (n=5) (Russell & Demko, 2005; Simonson, 2012; Singh, 2003; Soorenian, 2013; Wernsman, 2008). The ability of students with mobility impairments to prepare meals is significantly reduced if kitchens can only be accessed via stairs (Soorenian, 2013).

ICF Category (e1602): Products and Technology of Urban Land Development

Products and technology of urban land development was mentioned in 61 percent of the reviewed sources (n=30) (see Appendix L). The barriers (n=38) identified in these sources were more numerous than the facilitators (n=27). The most frequently cited facilitators were designated accessible parking spaces near the entrances of buildings (n=12) (Alrashidi, 2010; Cooper, 2012; Goode, 2007; Hadjikakou et al., 2010; Hall & Tinklin, 1998; Kennedy, 2005; Loinsky et al., 2003; NEADS, 2010; Singh, 2003; Smyser,2003; Tinklin & Hall, 1999; West et al., 1993), and campuses that had concentrated layouts (n=5) (Gilson & Deploy, 2011; Mohd-Nor et al., 2010; NEADS, 2010; Soorenian, 2013; Wernsman, 2008). Concentrated layouts focus on the concept of more buildings on less land and multiple buildings that provide the same amenities (Mohd-Nor et al., 2010). Other facilitators to physical accessibility include curb cuts or curb removal (n=5) (Chard & Couch, 1998; Cooper, 2012; Kennedy, 2000; Kennedy, 2005; Singh, 2003), covered walkways or tunnels that connect the entire campus (n=4) (Mohd-Nor et al., 2010; Salmon, 2011; Tiedemann, 2008; West et al., 1993), and level pavements (n=1) (Chard

& Couch, 1998). The most frequently stated barrier to physical accessibility was the inadequate number of designated accessible parking spaces near the entrances of buildings (n=11) (Adam et al., 2008; Alrashidi, 2010; Barth, 2006; Borland & James, 1999; Chard & Couch, 1998; Cooper, 2012; Hadjikakou et al., 2010; Kennedy, 2000; Samson, 2010; Simonson, 2012; West et al., 1993). To expand on this theme, many of the sources further discussed the unpredictable availability of accessible parking spaces (n=6) (Alrashidi, 2010; Borland & James, 1999; Chard & Couch, 1998; Hadjikakou et al., 2010; Salmon, 2011; Singh, 2003). The literature described the use of accessible parking spaces by persons without permits as a common problem experienced by students with mobility impairments. Singh (2003) stated, "Designating parking spaces for disabled drivers does not necessarily guarantee that non-disabled drivers will leave those spaces free." The second most frequently mentioned barrier was campuses that have a dispersed layout (n=7) (Barth, 2006; Borland & James; 1999; Goode, 2007; Hopkins, 2011; Loinsky et al, 2003; Taylor, 2004; West et al, 1993), such as campuses that span large geographical distances and those that have sub-campuses. Other barriers include pathways that are lengthy, too steep, too narrow or have steps present (n=4) (Borland & James, 1999; Murphy & Murphy, 1997; Shevlin et al., 2004; Smyser, 2003), lack of curb cuts and poor location of curb cuts (n=4) (Cooper, 2012; Hebel, 2001; Simonson, 2012; Smyser, 2003), broken or uneven pavement (n=3) (Alrashidi, 2010; Chard & Couch, 1998; Simonson, 2012), absence of stop lights at cross walks (n=1) (Chard & Couch, 1998), absence of adequate lighting on campus paths to assist with transportation at night (n=1) (Borland & James, 1999), and temporary conditions (n=1), for example, construction sites that may create unanticipated barriers (Kennedy, 2005).

ICF Category (e2100): Land Forms

Barriers and facilitators related to land forms was mentioned in 24 percent of reviewed sources (n=12) (see Appendix M). The barriers (n=11) identified in these sources were more numerous than the facilitators (n=2). The only mentioned facilitator to physical accessibility was flat landscapes (n=2) (Samson, 2010; Tiedemann, 2008). The most frequently mentioned barrier with regards to land forms was the campus terrain, including campuses built on hilly terrains or steep inclines (n=8) (Gilson & Dymond, 2012; Goode, 2007; Hebel, 2001; Hill, 1992; Hopkins, 2011; Kennedy, 2005; Mohd-Nor et al., 2010; Salmon, 2011). Another barrier mentioned in the included sources was teaching and learning spaces that involve diverse areas (n=3) (Borland & James, 1999; Hopkins, 2011; Kim & Williams, 2012). This could include fieldwork sites such as towns, beaches, farms, forests, archaeological sites, oversea visits and seabeds, or international placements that require long-distance travel (Borland & James, 1999; Kim & Williams, 2012).

ICF Category (e2151): Population Density

Population density was discussed in 10 percent of reviewed sources (n=5) (see Appendix N). Population density was only presented in the context of negatively impacting physical accessibility. Navigating heavy crowds was mentioned in all five sources as a barrier (Borland & James, 1999; Gilson & Depoy; 2011; Murphy & Murphy, 1997; Simonson, 2012; Taylor, 2005). Crowding can potentially occur in classrooms, halls, elevators, and outdoor pathways (Taylor, 2004; Simonson, 2012).

ICF Category (e2253): Precipitation

Precipitation was mentioned in 8 percent of reviewed sources (n=4) (see Appendix O). The barriers (n=4) identified in these sources were more numerous than the facilitators (n=2). Difficulty navigating paths when snow and ice build up was mentioned as the most frequent

barrier to physical accessibility (n=3) (Gilson & Depoy, 2011; Simonson, 2012; West et al., 1993). The other barrier mentioned was rain and mud slides making pathways slippery (n=1) (Gilson & Dymond, 2012). Facilitators included built tunnels to ensure wheelchairs do not have to go through snow (n=1) (West et al., 1993) and snow removal on campus (n=1) (West et al., 1993).

Overall, the categories that presented the most barriers and facilitators to physical accessibility on post-secondary campuses were Design, Construction and Building Products and Technology for Gaining Access to Facilities Inside Buildings for Public Use, followed by Design, Construction and Building Products and Technology for Entering and Exiting Buildings for Public Use.

Discussion

As recommended by Levac et al. (2010), the meaning of the findings should be explained both in terms of how they relate to the study purpose, as described above, as well as how they impact future research, practice and policy. This section will therefore be framed by those two imperatives.

The majority of the included sources were published within North America and the United Kingdom. This is not surprising since these regions have been focusing a significant amount of attention on increasing the accessibility of public areas and reducing the impact of disability throughout the last 20 years. In addition, these regions also have well publicized accessibility legislation, including the ADA in the United States, the AODA in Ontario and the DDA in the United Kingdom (Department of Justice, 1990; Legislation Government UK, 1995; Ontario Ministry of Economic Development, Trade and Employment, 2005). It is also possible, however, that the majority of the included sources originated from these regions as only articles

published in English were included in this review and English is the native language within these geographical areas.

As was evident from the data, the included sources mentioned numerous barriers and facilitators to physical accessibility that span many realms of student life. Barriers that realistically cannot be removed were also mentioned, although infrequently, including hilly terrains, precipitation, and population density. It is evident that there is a broad focus on physical accessibility in existing literature that serves to increase awareness of the extent to which individuals with mobility impairments may experience difficulties when participating in post-secondary education.

Although the literature described multiple aspects of the physical environment, it is evident that barriers to physical accessibility continue to pose substantial problems for students with mobility impairments, as barriers were mentioned significantly more frequently than facilitators in the included sources, many of which had been written within the last ten years. The ability to document the frequency of cited barriers and facilitators based on evidence gleaned from this scoping review allowed us to draw useful conclusions both about the number and the nature of barriers and facilitators. To our knowledge, no previous research has been done to collect, organize, and present this data. We therefore believe our research can be seen as a valuable addition to the literature.

It was noted that overcoming some of the most frequently cited barriers necessitates changes that would require a significant amount of funding and resources. These changes are generally architectural in nature and include alterations such as installing accessible elevators in appropriate locations within campus buildings, providing accessible washrooms, and redesigning entryways to include ramps and automatic doors. Conversely, many facilitators entail

modifications to existing amenities that may be relatively inexpensive and require less in the way of resources. Such modifications include lowering the height of water fountains and public telephones, removing snow from campus walkways, and rearranging furniture to increase the physical accessibility of facilities. Other facilitators that may serve to counteract some of the existing barriers to ensure post-secondary institutions are welcoming to students with mobility limitations include the provision of detailed maps that provide information about barriers and accessibility, both within and outside of buildings, and provision of accessible transit systems, particularly for large or multi-site campuses and/or those with hilly terrain.

On the whole, it was also evident from the literature that facilitators for the physical accessibility of post-secondary institutions tended to be put in place in reaction to identified problems, meaning that change often occurred on an ad hoc basis or when a specific issue was identified. Altering the physical environment in this way often leads to resolutions that are limited in nature and that tend to not serve the needs of an entire potential population of students with mobility impairments; retrofitting buildings is also expensive and often results in less optimal outcomes (Hall & Tinklin, 1998). If standard practice were to eliminate barriers by using a more proactive model for environmental modifications, such as a universal design model, this could potentially lead to a significant improvement in the physical accessibility of post-secondary institutions at reduced costs (The Center for Universal Design in Education, 2007; Hall & Tinklin, 1998).

Incorporation of universal design principles can also enhance usability of spaces. Usability as it applies to post-secondary education takes the person-environment relationship into account to ensure that all facilities on a campus can be used by all members of the student body, regardless of ability (Connell et al., 1997). The universal design principle of "equitable use" can

be used to illustrate areas where current accessibility standards could be enhanced. For example, post-secondary schools have made accessible seating available within classrooms, but often the locations of accessible seating segregates students with mobility impairments to the front row or near doorways (Connell et al., 1997; Simonson, 2012). If the principle of equitable use were to be applied during the design of classroom seating, all seating would be accessible to all students. Therefore, individuals with varying degrees of function could freely choose a seating location, as opposed to those with mobility impairments being restricted to a specific area.

Implications for Occupational Therapy

The knowledge generated through this scoping review can provide evidence for occupational therapists to promote health and well-being in students with mobility impairments by ensuring successful participation in post-secondary education. As such, occupational therapists might take a proactive role in promoting students' access to the physical environment in post-secondary institutions, since they are educated about the relationship between human functioning, disability, and environments. Occupational therapists are therefore are well-positioned to promote change both at an individual and a systems level (Canadian Association of Occupational Therapy [CAOT], 2002).

Knowledge of the barriers and facilitators that exist within the physical environment, in conjunction with knowledge of accessibility legislation and guidelines can be used by occupational therapists to support participation and raise awareness of existing occupational barriers and injustices with individual clients in order to support involvement in all realms of student life. Additionally, occupational therapists can enable students with disabilities to advocate for their unique rights by lobbying for change, joining accessibility committees, and/or creating awareness within their immediate post-secondary institutions and communities.

Occupational therapists might also utilize this knowledge to promote change at a macro-environmental level. The profession has a role and responsibility to synthesize knowledge to support participation in education, to identify and raise awareness of the physical barriers that exist within post-secondary institutions, and to work with groups, communities and society to enhance participation for individuals with mobility impairments (World Federation of Occupational Therapists [WFOT], 2006).

Knowledge Gaps

The literature frequently recommended that post-secondary institutions develop accessibility committees to undergo planning for creating accessible campuses that will address the needs of students with mobility impairments. However, there is a little in the literature that provides specific guidance on how to create and implement plans for the design and construction of accessible campuses or on how to allocate funding priorities. Therefore, it is evident that more research needs to be conducted to generate knowledge regarding practical and strategic measures for implementing accessibility plans, including acquiring funding sources, effective resource allocation, and cost-effectiveness of various initiatives. Key stakeholders such as government officials, educators, policy makers, disability officers, students with mobility impairments, lobby groups for persons with disabilities, and rehabilitation professionals like occupational therapists, may all have a role to play in developing and utilizing such research.

Knowledge Translation

As presented in the findings, a significant amount of valuable information regarding the barriers and facilitators to physical accessibility in post-secondary institutions exists. However, no explicit methods to facilitate knowledge translation were discussed. Knowledge translation is defined as the exchange, synthesis and application of knowledge, through the interactions of researchers and users, to capture the benefits of research to improve health and create more

effective services and products (Lencucha, Kothari, &Rouse, 2007). As a result, key stakeholders, including students with and without disabilities, parents, post-secondary school administrators, and policy makers may be unaware of the existing barriers and facilitators to physical accessibility. If a method of dissemination were to be implemented that provides access to the knowledge generated through this review, as well as information regarding existing accessibility legislation, students with disabilities and other key stakeholders could be empowered to take a stand for their rights, and advocate to improve the physical accessibility of post-secondary institutions.

In order to facilitate knowledge translation, it would be beneficial to utilize an internationally recognized framework, such as the ICF. The ICF is a framework situated in the realm of healthcare that is both standardized and accepted worldwide and could therefore aid in disseminating information across language and cultural barriers. As is evident in this review, the ICF nomenclature is useful for organizing large amounts of information and complex findings into distinct categories that highlight critical issues. These highlighted categories make it simple for people in the general public to understand the importance of research findings, and therefore, individuals may be more likely to use this information to promote physical accessibility in their community.

Limitations

Scoping reviews are often challenging to conduct as they require the researchers to search the literature for complex and vaguely defined topics. To guide our systematic search, we defined accessibility as the extent to which a product, service, or environment is available to as many people as possible (Ansley, 2000). However, in our included sources there was a lack of clarity with respect to the word itself, and to the definition of physical accessibility. In addition,

scoping reviews often have a broad focus, so it was necessary to narrow our search to focus on physical accessibility for persons with mobility limitations (Levac et al., 2010). As a result, sources that discussed physical accessibility in the context of other types of disabilities, including visual and hearing impairments, were excluded. In addition, since we were unable to focus on the ICF environmental factors regarding support and relationships, attitudes, and services, systems and policies, as they do not explicitly describe the physical environments, relevant sources may have been inadvertently overlooked. Additional limitations include exclusion of literature not written in the English language, the possibility of overlooking search terms that may have been used in other countries or cultures, and not assessing the quality of the reviewed literature. Therefore, this study cannot be considered an exhaustive account of the literature available in this area, despite the comprehensive approach used throughout the search.

Many voices were represented in the reviewed sources to generate knowledge regarding the physical accessibility of post-secondary institutions, including the perspectives of faculty, students with and without mobility impairments, administrators, and policy-makers. When the extracted data was being organized into the ICF categories, it was not possible to explicitly describe whose voice was being represented in each cited barrier and facilitator. It would be beneficial for future researchers interested in this topic area to focus more attention on whose voices are represented and to analyse the patterns that may exist in each groups' perspective.

Conclusion

This scoping review provides a map of the available literature that addresses the barriers and facilitators of physical accessibility in post-secondary institutions for individuals with mobility impairments. A multitude of barriers and facilitators exist that span all aspects of student life. However, it is evident that barriers still pose substantial problems for students with

mobility impairments, as barriers were mentioned more frequently than facilitators, despite the existence of accessibility legislation throughout the world. Occupational therapists, with knowledge of human functioning, universal design, and the information generated in this review, are well-positioned to use this knowledge to remove barriers related to education. Occupational therapists can advocate for their clients to promote inclusion in education, consult with architects to promote accessible building design and be involved on accessibility committees to influence the creation of new policies and guidelines, for example.

The lives of students with disabilities may be enhanced by bridging the knowledge gaps that exist within the available literature. Considering the perspectives of students, faculty, and other key stakeholders will be an important avenue for future research. Governing bodies and key decision makers working collaboratively may be able to generate knowledge to guide practical aspects of implementing accessibility plans, including funding and resource allocation, into the future. Finally, it will be important to work on facilitating knowledge translation to ensure that the public is well-educated about the current state of accessibility in order to support the goal of accessible communities.

References (for Background)

Accessibility for Ontarians with Disabilities Act Alliance. (2014). *Ontarians with Disabilities Act Alliance Update.* Retrieved from http://www.aodaalliance.org/strong-effective-aoda/03272014.asp.

Accessibility for Ontarians with Disabilities Act Alliance. (2013). *Accessibility for Ontarians with Disabilities Act Alliance Update.* Retrieved from ttp://www.aodaalliance.org/strong-effective-aoda/10292013.asp.

Alberani, V., Pietrangeli, P., &Mazza, A. (1990). The use of grey literature in health sciences: A preliminary survey. *Bulletin of the Medical Library Association, 78,* 358-363.

Ansley, J. (2000). *Creating accessible schools: National clearinghouse for educational facilities*. Washington, DC: National Institute of Building Sciences.

Arskey, H.,& O'Malley, L. (2005).Scoping Studies: Towards a Methodological Framework. *International Journal of Social Research Methodology, 8,*19-32.

Brown, C.L., & Herbert Emery, J.C. (2010). The Impact of Disability on Earnings and Labour Force Participation in Canada: Evidence from the 2001 PALS and from Canadian Case Law. Journal of Legal Economics,16, 19-59.

Canadian Association of Occupational Therapists (CAOT). (2002). *Enabling occupation: An occupational therapy perspective* (Rev. ed.). Ottawa, ON: CAOT Publications ACE.

Canadian Information Center for International Credentials. (1990). *Postsecondary Education Systems in Canada: An Overview.* Retrieved from http://www.cicic.ca/421/an-overview.canada.

Christ, T.,& Stodden, R. (2005). Advantages of developing survey constructs when comparing educational supports offered to students with disabilities in postsecondary education. *Journal of Vocational Rehabilitation, 22,* 23-31.

Connell, B., Jones, M., Mace, R., Mueller, J., Mullick, A., Ostroff, E., Sanford, J., Steinfeld, E., Story, M., & Vanderheiden, G. (1997). *The principles of universal design.* Retrieved from http://www.ncsu.edu/ncsu/design/cud/about_ud/udprinciplestext.htm.

Consort. (2010). *Consort: Transparent reporting of trials.* Retrieved from http://www.consort-statement.org/consort-statement/overview0/#checklist.

Department of Justice. (1990). *Americans with Disabilities Act of 1990.* Retrieved from http://www.ada.gov/pubs/ada.htm.

Department of Justice. (2010). *2010 ADA standards for accessible design.* Retrieved from http://www.ada.gov/regs2010/2010ADAStandards/2010ADAstandards.htm.

Hall, J., & Tinklin, T. (1998). Students first: The experiences of disabled students in higher education. (Doctoral dissertation). Retrieved from ERIC. (419476).

Hill, J. (1992). Accessibility: Students with disabilities in universities in Canada. *The Canadian Journal of Higher Education*, *12,* 48-83.

Legislation Government UK. (1995). *Disability Discrimination Act 1995.* Retrieved from http://www.legislation.gov.uk/ukpga/1995/50/contents.

Levac, D., Colquhoun, H., & O'Brien, K. (2010, September 20). Scoping studies: Advancing a methodology. *Implementation Science, 5,*59-68.

Lencucha, R., Kothari, A., & Rouse, M. (2007). Knowledge translation: A concept for occupational therapy? *American Journal of Occupational Therapy, 61,* 593-596.

Manitoba Disabilities Issues Office. (2013). *Accessibility Legislation Introduced in Manitoba*. Retrieved from http://www.gov.mb.ca/dio/.

Meyers, A., Anderson, J., Miller, D., Shipp, K., & Helen, H. (2002). Barriers, facilitators, and access for wheelchair users: Substantive and methodologic lessons from a pilot study of environmental effects. *Social Science & Medicine, 55,* 1435-1446.

McCloy, U., & DeClou, L. (2013). Disability in Ontario: Postsecondary education participation rates, student experience and labour market outcomes. Higher Education Quality Council of Ontario @ Issue Paper No. 14. February 21, 2013. Retrieved from http://heqco.ca/SiteCollectionDocuments/At%20Issue%20%20Disability%20in%20ON_ENG.pdf

McColl, M., Schaub, M., Sampson, L., & Hong, K. (2010). *Canadian disability policy alliance: A Canadians with disabilities act?* Kingston: Queen's University Centre for Health Services & Policy Research.

Ministry of Economic Development, Trade and Employment. (2013). *Making Ontario accessible: Built environment.* Retrieved from http://www.mcss.gov.on.ca/en /mcss/programs/accessibility/built_environment/index.aspx.

National Council on Disability. (2003). People with disabilities and postsecondary education: Position paper. Retrieved from http://www.ncd.gov/publications/2003/Sept152003

National Educational Association of Disabled Students. (n.d.) *Enhancing Accessibility in Post-Secondary Education Institutions : A Guide for Disability Service Providers*. Retrieved from http://www.neads.ca/en/norc/eag/eag_en.pdf

Norrie, K., & Lin, S. (2009). *Postsecondary educational attainment and participation in Ontario.* Toronto: Higher Education Quality Council of Canada.

Ontario Ministry of Economic Development, Trade and Employment. (2005). *About the Accessibility for Ontarians with Disabilities Act.* Retrieved from http://www.mcss.gov.on.ca/en/mcss/programs/accessibility/understanding_accessibility/aoda.aspx.

Ontario Ministry of Economic Development, Trade and Employment. (2013). *Making Ontario accessible: Built environment.* Retrieved from http://www.mcss.gov.on.ca/en/mcss/programs/accessibility/built_environment/index.aspx.

Polatajko, H., Davis, J., Hobson, S., Landry, J., Mandich, A., & Street, S. (2004). Meeting the responsibility that comes with the privilege: Introducing a taxonomic code for understanding occupation. *Canadian Journal of Occupational Therapy, 71*, 261-264.

Service Ontario. (1990). *Ontario education act, R.S.O. 1990, Chapter E.2*. Retrieved from http://www.e-laws.gov.on.ca/html/statutes/english/elaws_statutes_90e02_e.htm#Top.

Service Ontario. (2001). *Ontarians with disabilities act, S.O. 2001, chapter 32.* Retrieved from http://www.e-laws.gov.on.ca/html/statutes/english/elaws_statutes_01o32_e.htm.

Shaw, L. (2013, April 5). Workshop on Selection Assessment for Reviews, School of Occupational Therapy, Western University, London, Ontario.

Simonson, S. (2012). Measuring perceived accessibility of students with disabilities at a public university. (Unpublished doctoral dissertation). Colorado State University, Fort Collins, Colorado.

Statistics Canada. (2006). *Participation and Activity Limitation Survey*. Ottawa: Minister of Industry, 2008. (2006 Census of Canada).

Stodden, R., Whelley, T., Chang, C., & Harding, T. (2011). Current status of educational support provision to students with disabilities in postsecondary education. *Journal of Vocational Rehabilitation, 16*, 189-198.

The Center for Universal Design in Education. (2007). *Applications of Universal Design in Postsecondary Education.* Retrieved from http://www.washington.edu/doit/CUDE/app_postsec.html.

The Undergraduate Science Librarian. (n.d.). *Types of scientific literature.* Retrieved from http://undergraduatesciencelibrarian.org/a-very-brief-introduction-to-the-scientific-literature/types-of-scientific-literature/.

Townsend, E., & Polatajko, H. (2007). *Enabling occupation II: Advancing an occupational therapy vision for health, well-being, & justice through occupation.* Ottawa, ON: CAOT Publications ACE.

World Federation of Occupational Therapists. (2006). *Position statement on human rights.* Retrieved from http://www.nzaot.com/downloads/contribute/HumanRights PositionStatementFinal.pdf.

World Health Organization. (2001). *International Classification of Functioning, Disability and Health (ICF).* Geneva, CH: World Health Organization.

References (for Data Extraction)

Adam, D., Cornelisse, D., Harding, J., Zambon, J., Baptiste, S. & Steggles, E. (2008). Occupational therapy: Paving the way for accessibility on campus. *Occupational Therapy Now, 10,* 13-15.

Alrashidi, A. (2010). *University education and students' perceptions of physical disabilities at Kuwait university*. (Doctoral dissertation). Retrieved from ProQuest. (3444468).

Barth, B. (2006). *Facing challenges on campus: The experiences of postsecondary students with disabilities*. (Unpublished doctoral dissertation). The University of Manitoba, Winnipeg.

Borland, J., & James.S. (1999). The learning experience of students with disabilities in higher education: A case study of a UK university. *Disability & Society, 14,* 85-101.

Canadian Council on Learning. (2009). *Strategies for overcoming barriers to training and education for Canadians with disabilities.* Ottawa, ON: Canadian Council on Learning.

Carpenter, S. (1996). The Americans with Disabilities Act: Accommodations in Ohio. *Colleges & Research Libraries, 57,* 555-566.

Chard, G., & Couch, R. (1998).Access to higher education for the disabled student: A building survey at the University of Liverpool. *Disability & Society, 13,* 603-623.

Cooper, L. (2012). *Disability as diversity: Assessing the perceptions of students with physical disabilities regarding access and equal opportunity in postsecondary education*. (Unpublished doctoral dissertation). George Washington University, Washington. D.C.

Dolce, S. (2007). *Being a student: The process of participation by students with mobility limitations at the University of Buffalo*. (Doctoral dissertation). Retrieved from ProQuest. (3244281).

Faraday, S., & Mandslay, L. (2000).*FE college disability statements: An evaluation.* London, ENG: Stephen Austin and Sons Ltd.

Farone, M., Hall, E., & Costello, J. (1998). Postsecondary disability issues: An inclusive identification strategy. *Journal of Postsecondary Education and Disability, 13*, 35-45.

Gilbert, M. (2013). *Schools make adjustments to comply with updated standards to make campuses more accessible to the disabled*. Retrieved from http://diverse education.com/article/51840/#.

Gilson, C., &Dymond, S. (2012). Barriers impacting students with disabilities at a Hong Kong university. *Journal of Postsecondary Education and Disability, 25,* 103–118.

Gilson, S., &Depoy, E. (2011).The intersection of spatial design, architecture, and cultural policy in university communities.*Disability and Community Research in Social Science and Disability, 6*, 27-47.

Goode, J. (2007). 'Managing' disability: Early experiences of university students with disabilities. *Disability & Society, 22,* 35-48.

Hadjikakou, K., Polycarpou, V., & Hadjilia, A. (2010). The experiences of students with mobility disabilities in Cypriot higher education institutions: Listening to their voices. *International Journal of Disability, Development and Education, 57*, 403-426.

Harrison, A.G., & Wolforth, J. (2012). Findings from a Pan-Canadian survey of Disability Services Providers in Postsecondary Education. *International Journal of Disability, Community & Rehabilitation, 11*(1), Retrieved from http://www.ijdcr.ca/VOL11_01/articles/harrison.shtml

Hall, J., & Tinklin, T. (1998). *Students first: The experiences of disabled students in higher education*. (Doctoral dissertation). Retrieved from ERIC. (419476).

Hebel, S. (2001). How a landmark anti-bias law changed life for disabled students. *Chronicle of Higher Education, 47,* 23-26.

Hill, J. (1992). Accessibility: Students with disabilities in universities in Canada. *The Canadian Journal of Higher Education, 12,* 48-83.

Holloway, S. (2001). The experience of higher education from the perspective of disabled students. *Disability & Society, 16,* 597–615.

Hopkins, L. (2011). The path of least resistance: A voice-relational analysis of disabled students' experiences of discrimination in English universities. *International Journal of Inclusive Education, 15,* 711-727.

Johnson, A. (2006). *Students with disabilities in postsecondary education: Barriers to success and implications for professionals.* (Unpublished doctoral dissertation). University of Arkansas, USA.

Kennedy, M. (2000). Gaining access. *American School & University, 73,* 14-18.

Kennedy, M. (2005). Planning for inclusion. *American School & University, 78,* 20-26.

Kim, M., & Williams, B. (2012).Lived employment experiences of college students and graduates with physical disabilities in the United States. *Disability & Society, 27,* 837-852.

Lane, K., Swartz, S., & McNair, J. (1993).Implications of special education on school design: Practicality, not theory. *Educational Facility Planner, 31,* 6-9.

Loinsky, L., Levi, T., Saffey, K., &Jelsma, J. (2003).An investigation into the physical accessibility to wheelchair bound students of an institution of higher education in South Africa. *Disability and Rehabilitation, 25,* 305-308.

Mohd-Nor, M., Zulhanif, M., Razak, A., Usman, I., Che-Ani, A., Abdullah, N., & Tahir, M. (2010). Proceedings from 6th WSEAS International Conference on Energy, Environment, Ecosystems and Sustainable Development 2010: *The university development planning from the aspects of accessibility and circulation: A comparative study of four Malaysian universities*. Timisoara, Romania.

Murphy, D., & Murphy, J. (1997). Enabling disabled students. *NEA Higher Education Journal, 13*, 41-52.

National Educational Association of Disabled Students (NEADS). (2010). *Enhancing accessibility in post- secondary education institutions: A guide for disability service providers.* Retrieved from http://www.neads.ca.proxy2.lib.uwo.ca/en/norc/eag/eag_en.pdf.

Nelson, P. (1996). Library services for people with disabilities: Results of a survey. *Bulletin of the Medical Library Association, 84*, 397-401.

Ontario Undergraduate Student Alliance. (2012). *Policy paper: Students with disabilities.* Retrieved from http://www.ousa.ca/wordpress/wp-content/uploads/2012/11/Students-with-Disabilities1.pdf.

O'Connor, U., & Robinson, A. (1999). Accession or exclusion? University and the disabled student: A case study of policy and practice. *Higher Education Quarterly, 53*, 88-103.

Pitt, V., & Curtin, M. (2004). Integration versus segregation: The experiences of a group of disabled students moving from mainstream school into special needs further education. *Disability & Society, 19*, 387-401.

Russell, D., &Demko, R. (2005). *Accommodating learners with disabilities in post-secondary education in Alberta: A review of policies, programs, and support services.* Retrieved from http://eae.alberta.ca.proxy1.lib.uwo.ca/media/134909/aldpss.pdf.

Salmon, J. (2011). Universal design for academic facilities. *New Directions for Student Services, 134,* 13-20.

Samson, S. (2010). Best practices for serving students with disabilities. *Reference Services Review*, *39,* 260-277.

Shevlin, M., Kenny, M., &McNeela, E. (2004). Participation in higher education for students with disabilities: An Irish perspective. *Disability & Society, 19,* 15-30.

Simonson, S. (2012). *Measuring perceived accessibility of students with disabilities at a public university.* (Unpublished doctoral dissertation). Colorado State University, Fort Collins, Colorado.

Singh, D. (2003). Students with disabilities and higher education. *College Student Journal, 31,* 367-378.

Smyser, M. (2003). Accessibility: Maximum mobility and function. *American School and University Magazine,* 24-28.

Soorenian, A. (2013). Housing and transport: Access issues for disabled international students in British universities. *Disability and Society, 28,* 1-14.

Taylor, M. (2004). Widening participation into higher education for disabled students. *Education & Training*, *46,*40-48.

Tiedemann, C. (2008). Finding America's most disability-friendly colleges. *The Exceptional Parent, 38,* 28-30.

Tinklin, T., & Hall, J. (1999). Getting round obstacles: Disabled students' experiences in higher education in Scotland. *Studies in Higher Education, 24,* 183-194.

US Department of Justice. (2009). *A guide to disability rights laws.* Retrieved from http://www.ada.gov/cguide.htm.

Wernsman, M. (2008). *The process of designing and constructing an accessible residence hall for people with disabilities on a public university campus*. (Unpublished doctoral dissertation). Colorado State University, Fort Collins, Colorado.

West, M., Kregel, J., Getzel, E., Zhu, M., Ipsen, S., & Martin, E. (1993). Beyond section 504: Satisfaction and empowerment of students with disabilities in higher education. *The Exceptional Parent, 59,* 456-467.

Wu, W., Gan, A., Cevallos, F., & Hadi, M. (2011). Multiobjective optimization model for prioritizing transit stops for ADA improvements. *Journal of Transportation Engineering, 137,* 580-539.

Appendix A: Inclusion and Exclusion Criteria for Title Screen

Is this article relevant to the accessibility of post-secondary schools for individuals with mobility impairments?

Hint 1: Exclude if the focus is not on mobility impairments.

Hint 2: Exclude if the article does not pertain to post-secondary institutions.

Hint 3: Keywords for accessibility: barrier-free design, universal design, inclusive environment, physical access, architecture.

Hint 4: Keywords for educational facilities: school, post-secondary, college, university, education, campus.

Hint 5: Keywords for mobility impairment: physical disability, gait disturbance, walking impairment, wheelchair, handicap, disabled.

Hint 6: If title is vague or does not fully clarify the purpose of the article, include for further screening.

Hint 7: If “yes” or “maybe”, include. If “no”, exclude.

Appendix B: Inclusion and Exclusion Criteria for Abstract Screen

Is this article relevant to the accessibility of post-secondary for individuals with mobility impairments?

Hint 1: Exclude if the focus is only on hearing or visual impairments.

Hint 2: Exclude if the article does not pertain to facilities on post-secondary campuses.

Hint 3: Keywords for accessibility: barrier-free design, universal design, inclusive environment, physical access, architecture.

Hint 4: Keywords for educational facilities: school, post-secondary, college, university, education.

Hint 5: Keywords for mobility impairment: physical disability, gait disturbance, walking impairment, wheelchair, handicap, disabled.

Hint 6: Include if article discusses the barriers and facilitators to accessibility, accessibility standards and compliance, and perceptions regarding accessibility.

Hint 7: Include if articles focus on the Americans with Disabilities Act specific to facilities on postsecondary campuses.

Hint 8: Exclude if article focuses on distance education or online education for postsecondary students.

Hint 9: If “yes”, include. If “no”, exclude.

Appendix C: Full-Text Relevancy Assessment Scale

5: Relevant to Evidence Literature

Article has a primary focus on the accessibility of post-secondary institutions for individuals with mobility impairments and explicitly mentions barriers and facilitators of accessibility, accessibility standards and compliance, and/or perceptions regarding accessibility.

4: Moderately Relevant to Evidence Literature

Article has a primary focus on the accessibility of educational facilities for individuals with mobility impairments but does not explicitly mention barriers and facilitators of accessibility, accessibility standards and compliance, and/or perceptions regarding accessibility.

3: Fairly Relevant to Evidence Literature

Article explicitly mentions the accessibility of postsecondary institutions for individuals with mobility impairments; however, this topic is not the primary focus of the article.

2: Minimally Relevant to Evidence Literature

Article has a primary focus on the accessibility of environments for individuals with mobility impairments, but is not explicitly focused on postsecondary institutions.

1: Not Relevant for Inclusion in Review

Article does not explicitly address the accessibility of postsecondary institutions for individuals with mobility impairments.

Appendix D: Google Drive Data Extraction Form

Page 1 of 1

Data Extraction Form

Form Description

Rater Name *
- Brittany Moore
- Nina Berardi
- Erin Miller
- Nathania Lukman

Reference ID *
Reference Number from Refworks

Title *

Database *
- Ovid Medline
- CINAHL
- PubMed
- Scopus
- ProQuest
- ERIC
- CBCA Education
- Engineering Village
- PsychInfo
- SocINDEX
- Development and Adolescent Studies
- Google

Journal Type *
- Health Sciences
- Social Sciences
- Education
- Engineering
- Grey Literature
- Other:

Keywords

- [ ] Academic Libraries
- [ ] Accessibility
- [ ] Americans with Disabilities Act (ADA)
- [ ] Architecture
- [ ] Attitudinal Issues
- [ ] Best Practice
- [ ] Campus Planning
- [ ] Circulation
- [ ] College
- [ ] Compliance
- [ ] Disabled People
- [ ] Educational Facilities (and Design)
- [ ] Education Policy
- [ ] Educational Strategies
- [ ] Equal Opportunities/Rights Issues
- [ ] Higher Education
- [ ] Inclusive Schools
- [ ] Learning Environment
- [ ] Legislation
- [ ] Mainstream School
- [ ] Navigation
- [ ] Physical Disorders
- [ ] Physical Planning
- [ ] Post-Secondary Education
- [ ] Special Education
- [ ] School Buildings
- [ ] Student Body
- [ ] Sustainable Campus
- [ ] Transit Stops
- [ ] Universal Design
- [ ] Wheelchair
- [ ] Integration
- [ ] Physical Impairments
- [ ] People with Disabilities
- [ ] College Students with Disabilities
- [ ] Participation
- [ ] University Student

- [ ] Environmental Modifications
- [ ] Mobility Disabilities
- [ ] Physical Access
- [ ] Disabled International Students
- [ ] Housing

- [ ] Transport
- [ ] Physical Barriers
- [ ] Higher education access
- [ ] Post-secondary transition
- [ ] Academic adjustments
- [ ] Services for students with disabilities
- [ ] Employment outcomes
- [ ] University
- [ ] Disability barriers
- [ ] Access
- [ ] Admissions practices

Origin of Study *
Country

- ( ) Australia
- ( ) Canada
- ( ) Malaysia
- ( ) South Africa
- ( ) U.K.
- ( ) USA
- ( ) Macedonia
- ( ) Scotland
- ( ) Cyprus
- ( ) Ireland
- ( ) Kuwait
- ( ) Cyprus
- ( ) China

Year *
Year Study was Conducted NOT Published

- ( ) 1990
- ( ) 1991
- ( ) 1992
- ( ) 1993
- ( ) 1994
- ( ) 1995
- ( ) 1996

- 1997
- 1998
- 1999
- 2000
- 2001
- 2002
- 2003
- 2004
- 2005
- 2006
- 2007
- 2008
- 2009
- 2010
- 2011
- 2012
- 2013

Study Type *

- Quantitative
- Qualitative
- Grey Literature
- Literature Review
- Survey
- Case Study
- Grounded Theory
- Interview
- Observation
- Conference
- Report
- Focus Group(s)
- Thesis/Dissertation
- Laws/Statutes

Barriers to Accessibility on Post-Secondary Campuses: Products and Technology

Barriers to Accessibility on Post-Secondary Campuses: Physical and Material Features of the Environment

Barriers to Accessibility on Post-Secondary Campuses: Social Support and Relationships

Barriers to Accessibility on Post-Secondary Campuses: Attitudes

Barriers to Accessibility on Post-Secondary Campuses: Services, Systems and Policies

Facilitators to Accessibility on Post-Secondary Campuses: Products and Technology

Facilitators to Accessibility on Post-Secondary Campuses: Physical and Material Features of the Environment

Facilitators to Accessibility on Post-Secondary Campuses: Social Support and Relationships

Facilitators to Accessibility on Post-Secondary Campuses: Attitudes

Facilitators to Accessibility on Post-Secondary Campuses: Services, Systems and Policies

Accessibility Standards and Compliance in Post-Secondary Institutions

Perceptions of Students with Mobility Impairments

Perceptions of Key Stakeholders (e.g., teachers, administration, parents, accessibility committees and policy makers)

Other
Other Important Themes

Appendix E: Environmental Factors of the ICF

Products and Technology

1) General Products and Technology for Personal Indoor and Outdoor Mobility and Transportation (ICF Category - e1200): equipment, products and technologies used by people in activities of moving inside and outside buildings, such as motorized and non-motorized vehicles used for the transportation of people over ground, water and air (e.g., buses, cars, vans, motor-powered vehicles), not adapted or specially designed.

2) Design, Construction and Building Products and Technology for Entering and Exiting Buildings for Public Use (ICF Category - e1500): products and technology of entry and exit from the human-made environment that is planned, designed and constructed for public use, public buildings, portable and stationary ramps, power-assisted doors, lever door handles and level door thresholds.

3) Design, Construction and Building Products and Technology for Gaining Access to Facilities Inside Buildings for Public Use (ICF Category - e1501): products and technology of indoor facilities in design, building and construction for public use, such as washroom facilities, telephones, lifts or elevators, escalators, thermostats and dispersed accessible seating

4) Design, Construction and Building Products and Technology for Way Finding, Path Routing and Designation of Locations in Buildings for Public Use (ICF Category - e1502): indoor and outdoor products and technology in design, building and construction for public use to assist people to find their way inside and immediately outside buildings and locate the places they want to go, such as size of corridors, floor surfaces, accessible kiosks, and other forms of directories.

5) Design, Construction and Building Products and Technology for Gaining Access to Facilities in Buildings for Private Use (ICF Category - e1551): products and technology related to design,

building and construction inside buildings for private use, such as washroom facilities, telephones, audio loops, kitchen cabinets, appliances and electronic controls in private homes.

6) Products and Technology of Urban Land Development (ICF Category - e1602): products and technology in urban land areas as they affect an individual's outdoor environment through the implementation of urban land use policies, design, planning and development of space, such as kerb cuts, ramps, and street lighting.

Natural Environment and Human-Made Changes to Environment

7) Land Forms (ICF Category - e2100): features of land forms such as mountains, hills, valleys and plains.

8) Population Density (ICF Category - e2151): number of people per unit of land area, including features such as high and low density.

9) Precipitation (ICF Category - e2253): falling of moisture, such as rain, dew, snow, sleet and hail.

(WHO, 2001)

Appendix F: Characteristics of Sources Included for Data Extraction

References	Origin of Study	Article/Source Type
Adam, D., Cornelisse, D., Harding, J., Zambon, J., Baptiste, S. & Steggles, E. (2008). Occupational therapy: Paving the way for accessibility on campus. *Occupational Therapy Now, 10*, 13-15.	Canada	Editorial
Alrashidi, A. (2010). *University education and students' perceptions of physical disabilities at Kuwait university*. (Doctoral dissertation). Retrieved from ProQuest. (3444468).	Kuwait	Primary research article; mixed methods
Barth, B. (2006). *Facing challenges on campus: The experiences of postsecondary students with disabilities*. (Unpublished doctoral dissertation). The University of Manitoba, Winnipeg.	Canada	Primary research article; qualitative methods
Borland, J., & James. S. (1999). The learning experience of students with disabilities in higher education: A case study of a UK university. *Disability & Society, 14*, 85-101.	U.K.	Primary research article; qualitative methods
Canadian Council on Learning. (2009). *Strategies for overcoming barriers to training and education for Canadians with disabilities.* Ottawa, ON: Canadian Council on Learning.	Canada	Primary research article; qualitative methods
Carpenter, S. (1996). The Americans with Disabilities Act: Accommodations in Ohio. *Colleges & Research Libraries, 57*, 555-566.	USA	Primary research article; quantitative methods
Chard, G., & Couch, R. (1998). Access to higher education for the disabled student: A building survey at the University of Liverpool. *Disability & Society, 13*, 603-623.	U.K.	Primary research article; qualitative methods
Cooper, L. (2012). *Disability as diversity: Assessing the perceptions of students with physical disabilities regarding access and equal opportunity in postsecondary education*. (Unpublished doctoral dissertation). George Washington University, Washington. D.C.	USA	Dissertation
Dolce, S. (2007). *Being a student: The process of participation by students with mobility limitations at the University of Buffalo*. (Doctoral dissertation). Retrieved from ProQuest. (3244281).	USA	Primary research article; qualitative methods

Faraday, S., & Mandslay, L. (2000). *FE college disability statements: An evaluation.* London, ENG: Stephen Austin and Sons Ltd.	U.K.	Primary research article; qualitative methods
Farone, M., Hall, E., & Costello, J. (1998). Postsecondary disability issues: An inclusive identification strategy. *Journal of Postsecondary Education and Disability, 13*, 35-45.	USA	Primary research article; qualitative methods
Gilbert, M. (2013). *Schools make adjustments to comply with updated standards to make campuses more accessible to the disabled*. Retrieved from http://diverseeducation.com/article/51840/#.	USA	Editorial
Gilson, C., & Dymond, S. (2012). Barriers impacting students with disabilities at a Hong Kong university. *Journal of Postsecondary Education and Disability, 25*, 103–118.	China	Primary research article; qualitative methods
Gilson, S., & Depoy, E. (2011). The intersection of spatial design, architecture, and cultural policy in university communities. *Disability and Community Research in Social Science and Disability, 6*, 27-47.	USA	Primary research article; qualitative methods
Goode, J. (2007). 'Managing' disability: Early experiences of university students with disabilities. *Disability & Society, 22*, 35-48.	U.K.	Primary research article; qualitative methods
Hadjikakou, K., Polycarpou, V., & Hadjilia, A. (2010). The experiences of students with mobility disabilities in Cypriot higher education institutions: Listening to their voices. *International Journal of Disability, Development and Education, 57*, 403-426.	Cyprus	Primary research article; qualitative methods
Hall, J., & Tinklin, T. (1998). *Students first: The experiences of disabled students in higher education*. (Doctoral dissertation). Retrieved from ERIC. (419476).	U.K.	Primary research article; qualitative methods
Hebel, S. (2001). How a landmark anti-bias law changed life for disabled students. *Chronicle of Higher Education, 47*, 23-26.	USA	Primary research article; qualitative methods
Hill, J. (1992). Accessibility: Students with disabilities in universities in Canada. *The Canadian Journal of Higher Education, 12*, 48-83.	Canada	Primary research article; quantitative methods
Holloway, S. (2001). The experience of higher education from the perspective of disabled students. *Disability & Society, 16*, 597–615.	U.K.	Primary research article; qualitative methods

Hopkins, L. (2011). The path of least resistance: A voice-relational analysis of disabled students' experiences of discrimination in English universities. *International Journal of Inclusive Education, 15,* 711-727.	U.K.	Primary research article; qualitative methods
Johnson, A. (2006). *Students with disabilities in postsecondary education: Barriers to success and implications for professionals*. (Unpublished doctoral dissertation). University of Arkansas, USA.	USA	Dissertation
Kennedy, M. (2000). Gaining access. *American School & University, 73,* 14-18.	USA	Primary research article; qualitative methods
Kennedy, M. (2005). Planning for inclusion. *American School & University, 78,* 20-26.	USA	Editorial
Kim, M., & Williams, B. (2012). Lived employment experiences of college students and graduates with physical disabilities in the United States. *Disability & Society, 27,* 837-852.	USA	Primary research article; qualitative methods
Lane, K., Swartz, S., & McNair, J. (1993). Implications of special education on school design: Practicality, not theory. *Educational Facility Planner, 31,* 6-9.	Canada	Primary research article; quantitative methods
Loinsky, L., Levi, T., Saffey, K., & Jelsma, J. (2003). An investigation into the physical accessibility to wheelchair bound students of an institution of higher education in South Africa. *Disability and Rehabilitation, 25,* 305-308.	South Africa	Primary research article; quantitative methods
Mohd-Nor, M., Zulhanif, M., Razak, A., Usman, I., Che-Ani, A., Abdullah, N., & Tahir, M. (2010). Proceedings from 6th WSEAS International Conference on Energy, Environment, Ecosystems and Sustainable Development 2010: *The university development planning from the aspects of accessibility and circulation: A comparative study of four Malaysian universities*. Timisoara, Romania.	Malaysia	Primary research article; mixed methods
Murphy, D., & Murphy, J. (1997). Enabling disabled students. *NEA Higher Education Journal, 13,* 41-52.	USA	Primary research article; qualitative methods
National Educational Association of Disabled Students (NEADS). (2010). *Enhancing accessibility in post- secondary education institutions: A guide for disability service providers.* Retrieved from http://www.neads.ca.proxy2.lib.uwo.ca/en/norc/eag/eag_en.pdf.	Canada	Technical report

Nelson, P. (1996). Library services for people with disabilities: Results of a survey. *Bulletin of the Medical Library Association, 84,* 397-401.	USA	Primary research article; quantitative methods
O'Connor, U., & Robinson, A. (1999). Accession or exclusion? University and the disabled student: A case study of policy and practice. *Higher Education Quarterly, 53,* 88-103.	U.K.	Primary research article; qualitative methods
Ontario Undergraduate Student Alliance. (2012). *Policy paper: Students with disabilities.* Retrieved from http://www.ousa.ca/wordpress/wp-content/uploads/2012/11/Students-with-Disabilities1.pdf.	Canada	Technical report
Pitt, V., & Curtin, M. (2004). Integration versus segregation: The experiences of a group of disabled students moving from mainstream school into special needs further education. *Disability & Society, 19,* 387-401.	U.K.	Primary research article; qualitative methods
Russell, D., & Demko, R. (2005). *Accommodating learners with disabilities in post-secondary education in Alberta: A review of policies, programs, and support services.* Retrieved from http://eae.alberta.ca.proxy1.lib.uwo.ca/media/134909/aldpss.pdf.	Canada	Review article
Salmon, J. (2011). Universal design for academic facilities. *New Directions for Student Services, 134,* 13-20. Retrived from http://journals1.scholarsportal.info.proxy1.lib.uwo.ca/tmp/1847962795392731575.pdf.	USA	Book series
Samson, S. (2010). Best practices for serving students with disabilities. *Reference Services Review, 39,* 260-277.	USA	Primary research article; quantitative methods
Shevlin, M., Kenny, M., & McNeela, E. (2004). Participation in higher education for students with disabilities: An Irish perspective. *Disability & Society, 19,* 15-30.	Ireland	Primary research article; qualitative methods
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Singh, D. (2003). Students with disabilities and higher education. *College Student Journal, 31,* 367-378.	USA	Primary research article; quantitative methods

Smyser, M. (2003). Accessibility: Maximum mobility and function. *American School and University Magazine*, 24-28.	USA	Editorial
Soorenian, A. (2013). Housing and transport: Access issues for disabled international students in British universities. *Disability and Society*, *28*, 1-14.	U.K.	Primary research article; qualitative methods
Taylor, M. (2004). Widening participation into higher education for disabled students. *Education & Training, 46*, 40-48.	U.K.	Primary research article; qualitative methods
Tiedemann, C. (2008). Finding America's most disability-friendly colleges. *The Exceptional Parent, 38,* 28-30.	USA	Editorial
Tinklin, T., & Hall, J. (1999). Getting round obstacles: Disabled students' experiences in higher education in Scotland. *Studies in Higher Education, 24*, 183-194.	U.K.	Primary research article; qualitative methods
US Department of Justice. (2009). *A guide to disability rights laws.* Retrieved from http://www.ada.gov/cguide.htm.	USA	Technical report
Wernsman, M. (2008). *The process of designing and constructing an accessible residence hall for people with disabilities on a public university campus*. (Unpublished doctoral dissertation). Colorado State University, Fort Collins, Colorado.	USA	Dissertation
West, M., Kregel, J., Getzel, E., Zhu, M., Ipsen, S., & Martin, E. (1993). Beyond section 504: Satisfaction and empowerment of students with disabilities in higher education. *The Exceptional Parent, 59,* 456-467.	USA	Primary research article; qualitative methods
Wu, W., Gan, A., Cevallos, F., & Hadi, M. (2011). Multiobjective optimization model for prioritizing transit stops for ADA improvements. *Journal of Transportation Engineering, 137*, 580-539.	USA	Primary research article; mixed methods

Appendix G: General Products and Technology for Personal Indoor and Outdoor Mobility and Transportation (ICF Category- e1200)

References	Facilitators to Physical Accessibility	Barriers to Physical Accessibility
Borland, J., & James. S. (1999). The learning experience of students with disabilities in higher education: A case study of a UK university. *Disability & Society, 14*, 85-101.		Limited Availability of Accessible Public Transportation: Some issues were raised by individual students about transport and access to facilities. One student reported "I live well out of College and there is only a very poor public transport service."
Canadian Council on Learning. (2009). *Strategies for overcoming barriers to training and education for Canadians with disabilities.* Ottawa, ON: Canadian Council on Learning.		Limited Availability of Accessible Public Transportation: One of the three main barriers encountered by students with disabilities was physical access. In some cases, accessible public transportation was not available and students had no way to travel to learning opportunities.
Cooper, L. (2012). *Disability as diversity: Assessing the perceptions of students with physical disabilities regarding access and equal opportunity in postsecondary education*. (Unpublished doctoral dissertation). George Washington University, Washington. D.C.	Accessible Mini-Bus Service: Structural accessibility was defined as a measurement of the availability of adaptive on-campus transportation services. Descriptive statistics outline the perceptions of availability of the following (with 5=strongly agree, to 1=strongly disagree): transportation system: 4.67.	Lack of Awareness of Available Accessible Transportation: 75% of respondents did not know whether their institution had an accessible or adapted transportation system in place for those with physical disabilities.

Dolce, S. (2007). *Being a student: The process of participation by students with mobility limitations at the University of Buffalo*. (Doctoral dissertation). Retrieved from ProQuest. (3244281).	Accessible Mini-Bus Service: Shuttle buses and adapted buses were frequently mentioned in the interviews by students who do not drive as facilitators to accessibility. One student stated "[the shuttle] will come and pick you up and take you over to whatever building you need to go to, and then whatever time you say you will return, they pick you up."	
Goode, J. (2007). 'Managing' disability: Early experiences of university students with disabilities. *Disability & Society, 22,* 35-48.	Accessible Mini-Bus Service: Campus includes a dedicated accessible minibus service to transport students with mobility difficulties and a free accessible 'hopper bus' service for all students. Both of these service buses run around and between sub-campuses.	
Hebel, S. (2001). How a landmark anti-bias law changed life for disabled students. *Chronicle of Higher Education, 47,* 23-26.	Accessible Mini-Bus Service: Over the past decade, many campuses have added transportation services that make it easier for students in wheelchairs to get around. One campus in particular offers a van service for students to get around on campus.	
Hill, J. (1992). Accessibility: Students with disabilities in universities in Canada. *The Canadian Journal of Higher Education, 12,* 48-83.	Community-Based Vehicle Support: In most cases transportation was provided by community-based companies (e.g., public or private taxi or bus).	

Kennedy, M. (2005). Planning for inclusion. *American School & University, 78,* 20-26.	Accessible Mini-Bus Service: Campus buses will be replaced with wheelchair accessible buses.	Inaccessible Transit Stops: The San Francisco school district's ADA Transition Plan spells out much needed action in passenger loading zones to ensure there is an accessible route to the main entrance.
Lane, K., Swartz, S., & McNair, J. (1993). Implications of special education on school design: Practicality, not theory. *Educational Facility Planner, 31,* 6-9.		Inaccessible Transit Stops: The school building must be accessible from public transportation stops. If accessible routes do not exist, it is a violation.
National Educational Association of Disabled Students (NEADS). (2010). *Enhancing accessibility in post- secondary education institutions: A guide for disability service providers.* Retrieved from http://www.neads.ca.proxy2.lib.uwo.ca/en/norc/eag/eag_en.pdf.	Accessible Mini-Bus Service: For large campuses, or colleges and universities with multiple campuses, there is a need to implement a shuttle service for students with disabilities, or a general shuttle service that is fully accessible.	
Russell, D., & Demko, R. (2005). *Accommodating learners with disabilities in post-secondary education in Alberta: A review of policies, programs, and support services.* Retrieved from http://eae.alberta.ca. proxy1.lib.uwo.ca/media/134909/aldpss.pdf.		Limited Availability of Accessible Public Transportation: Lack of reliable and accessible public transportation forms a formidable barrier to students with disabilities. Students can face be late for classes, miss classes altogether, and/or arrive at school exhausted.
Salmon, J. (2011). Universal design for academic facilities. *New Directions for Student Services, 134,* 13-20.		Limited Availability of Accessible Public Transportation: Transportation difficulties and navigational issues were present on many campuses. One campus in particular had accessible transportation methods that were only available during limited hours.

Shevlin, M., Kenny, M., & McNeela, E. (2004). Participation in higher education for students with disabilities: An Irish perspective. *Disability & Society, 19,* 15-30.		Limited Availability of Accessible Public Transportation: Availability of transportation is a factor for students in determining which university to attend. One student chose a university because the others would not allow her to transport her wheelchair around campus.
Singh, D. (2003). Students with disabilities and higher education. *College Student Journal, 31,* 367-378.		Limited Availability of Accessible Public Transportation: Only a small proportion of the sample institutions were considered structurally accessible (e.g., had adaptive on-campus transportation service).
Tiedemann, C. (2008). Finding America's most disability-friendly colleges. *The Exceptional Parent, 38,* 28-30.	Accessible Mini-Bus Service: The University of California at Berkeley offers on-campus vans, tram services and accessible public transportation services to students with disabilities. This can help students get to class on time and also take students to destinations off campus.	
Wu, W., Gan, A., Cevallos, F., & Hadi, M. (2011). Multiobjective optimization model for prioritizing transit stops for ADA improvements. Journal of Transportation Engineering, 137, 580-539.		Inaccessible Transit Stops: Inaccessible transit stops prevent people with disabilities from using fixed route transit services, thereby further limiting their mobility. Due to budget limitations, transit agencies can select only a limited number of transit stops for ADA improvements each year. The assigned budget for transit ADA improvements is $2.0 million per

		year (2006-2010). The ADA prescribes the minimum accessibility requirements. The Broward County Transit (BCT) in Florida possessed a transit-stop inventory that included data on 5,034 transit stops serving 43 bus routes; among these stops, 2,465 (49%) were not ADA compliant.

Appendix H: Design, Construction and Building Products and Technology for Entering and Exiting Buildings for Public Use (ICF Category- e1500)

References	Facilitators to Physical Accessibility	Barriers to Physical Accessibility
Adam, D., Cornelisse, D., Harding, J., Zambon, J., Baptiste, S. & Steggles, E. (2008). Occupational therapy: Paving the way for accessibility on campus. *Occupational Therapy Now, 10*, 13-15.	Design of Entrance Locations (Barrier-Free Pathways to Entrances): The pathway to an automatic door operator must be barrier-free for it to be functional.	Design of Ramps (Stairs Present with No Ramp): Key issues that emerged included barriers related to ramps. Design of Entrance Locations (Absent or Poorly Located Entrances): Key issues that emerged included barriers related to entrances. Design of Doors (Narrow Door Widths): Key issues that emerged included barriers related to doorways.
Alrashidi, A. (2010). *University education and students' perceptions of physical disabilities at Kuwait university*. (Doctoral dissertation). Retrieved from ProQuest. (3444468).	Design of Entrance Locations (Multiple Accessible Entrances): In general, the participants had positive attitudes toward main entrances. Furthermore, 58 % of participants stated that they are able to find accessible entrances on campus. Design of Entrances (Barrier-Free Pathways to Entrances): 62% of participants stated that they were able to find wide routes of barrier-free travel that led to main entrances.	Design of Doors (Heavy Doors): To be accessible, doors need to be able to open with minimal force. Design of Doors (Narrow Doors Widths): To be accessible, entrance doors must have at least a 32 inch clearance. Design of Ramps (Stairs Present with No Ramp): When considering accessibility, it is important to note whether stairs are present at the main entrance and if a ramp and/or lift is available for use.

Carpenter, S. (1996). The Americans with Disabilities Act: Accommodations in Ohio. *Colleges & Research Libraries, 57*, 555-566.		Construction to Undergo Accessibility Modifications (Older Buildings): Older buildings are difficult to gain access to and adapt, and may have a listed status (e.g. will be undergoing renovations). Many disabled students view this listed status with caution. Design of Doors (Lever Use or Push-Pull Doors): Lower scores were obtained on accessibility scales for a large proportion of libraries analyzed with respect to lever use for interior doors. Design of Doors (Narrow Door Widths): Lower scores were obtained on accessibility scales for a large proportion of the libraries analyzed with respect to widening existing doors (over 70% of libraries were not up to par).
Chard, G., & Couch, R. (1998). Access to higher education for the disabled student: A building survey at the University of Liverpool. *Disability & Society, 13*, 603-623.	Design of Doors (Automatic Doors): Automatic doors that are functional and have at least a 60 second delay before closing are beneficial.	Design of Doors (Heavy Doors): Heavy doors or doors that remain locked, causing students to use alternative entrances, increase the difficulties related to mobility on campus. Design of Doors (Lever Use or Push-Pull Doors): Push/pull doors instead of automatic doors decrease accessibility. Design of Doors (Swipe Card or Intercom Access): Swipe card or intercom access to

		buildings, especially if the equipment is located too high for individuals in wheelchairs to successfully operate. Design of Ramps (Stairs Present with No Ramp): No ramp access, meaning that entrances are only accessible by steps. Design of Doors (Narrow Door Widths): Not all doors have an opening width of at least 750 mm, as some had minimum door widths of only 600 mm. It is also helpful for doors to have widths adequate to accommodate a wheelchair. Construction to Undergo Accessibility Modifications (Older Buildings): The university's current policy is not to create any new buildings, but to restructure existing buildings.
Cooper, L. (2012). *Disability as diversity: Assessing the perceptions of students with physical disabilities regarding access and equal opportunity in postsecondary education*. (Unpublished doctoral dissertation). George Washington University, Washington. D.C.	Design of Doors (Automatic Doors): Structural accessibility was defined as a measurement of the availability of automatic doors and press buttons. 83% of respondents agreed or strongly agreed that the main doors to campus buildings had automatic door openers. Descriptive statistics outline the perceptions of availability of the following (with 5=strongly agree, to 1=strongly disagree): automatic doors: 4.25.	Design of Ramps (Stairs Present with No Ramp): Structural accessibility was defined as a measurement of the availability of ramps on all campus buildings. Descriptive statistics outline the perceptions of availability of the following (with 5=strongly agree, to 1=strongly disagree): ramps for building entry: 1.67.

Dolce, S. (2007). *Being a student: The process of participation by students with mobility limitations at the University of Buffalo*. (Doctoral dissertation). Retrieved from ProQuest. (3244281).	Design of Doors (Automatic Doors): Students gave the following suggestions for improvements to physical access at the University of Buffalo: more automatic doors and making sure that all automatic doors are functional.	
Gilbert, M. (2013). *Schools make adjustments to comply with updated standards to make campuses more accessible to the disabled*. Retrieved from http://diverseeducation .com/article/51840/#.	Design of Ramps (Presence of Ramps): Another change that the University of Alaska's accessibility committee approved was the installation of more ramps. Design of Ramps (Entrances with Even Entry; No Stairs or Ramps Required): The University of Miami is currently retrofitting buildings built in the 1800's to have even entry (e.g., the presence of level surfaces with no obstacles or ramps necessary).	
Gilson, S., & Depoy, E. (2011). The intersection of spatial design, architecture, and cultural policy in university communities. *Disability and Community Research in Social Science and Disability, 6,* 27-47.	Design of Doors (Automatic Doors): Students revealed which features of the physical environment they perceived as welcoming, which included automatic exterior doors in good repair. Design of Doors (Junctured Entrances and Exits): Students revealed which features of the physical environment they perceived as welcoming, which included fully junctured entrances and exits for all bodies.	Design of Ramps (Stairs Present with No Ramp): The authors found a continuum of exclusion throughout the campuses, including the presence of stairs. Design of Doors (Heavy Doors): The authors found a continuum of exclusion throughout campus, including heavy, inoperable automatic doors.
Goode, J. (2007). 'Managing' disability: Early experiences of university students with disabilities. *Disability & Society, 22,* 35-48.		Construction to Undergo Accessibility Modifications (Older Buildings): Older buildings that were built prior to the

		introduction of accessibility guidelines are less accessible than newer facilities.
Hadjikakou, K., Polycarpou, V., & Hadjilia, A. (2010). The experiences of students with mobility disabilities in Cypriot higher education institutions: Listening to their voices. *International Journal of Disability, Development and Education, 57*, 403-426.	Design of Ramps (Presence of Ramps): Students often mentioned ramps as a measure of good accessibility on campus.	Design of Ramps (Stairs Present and No Ramp): While some universities claimed to be accessible, a student who visited one such campus on a pre-admission interview found otherwise. Only a handful or ramps are available on campus, and some are wooden and cannot be used by individuals in wheelchairs. Construction to Undergo Accessibility Modifications (Older Buildings): Two participants complained about the accessibility of their school, which contains older buildings that have undergone no modifications.
Hall, J., & Tinklin, T. (1998). *Students first: The experiences of disabled students in higher education*. (Doctoral dissertation). Retrieved from ERIC. (419476).	Design of Ramps (Presence of Ramps): One student chose to attend her higher education institution mainly because it offered relatively good access to people with mobility difficulties, including ramps into all the main academic buildings.	Construction to Undergo Accessibility Modifications (Older Buildings): Since existing inaccessible buildings are being adapted, the result is often not as good as if the building had been designed to be accessible from the outset. Some buildings and departments remain inaccessible because there is no way to adapt them or because adaptations are competing for general institutional funds. Design of Entrance Locations (Absent or Poorly Located Entrances): Students with mobility difficulties are sometimes faced with extended journeys to find the one

		accessible entrance.
Hebel, S. (2001). How a landmark anti-bias law changed life for disabled students. *Chronicle of Higher Education, 47,* 23-26.	Design of Doors (Automatic Doors): One student who uses a wheelchair stated that all academic buildings should have automatic door openers.	Design of Entrance Locations (Absent or Poorly Located Entrances): When the ADA first passed, Purdue University lacked accessible entrances. Design of Ramps (Stairs Present with No Ramp): The cost of installing an outside ramp during renovation is approximately $70, 000. In general, Purdue University tends to lack accessible entrances.
Hill, J. (1992). Accessibility: Students with disabilities in universities in Canada. *The Canadian Journal of Higher Education, 12,* 48-83.		Construction to Undergo Accessibility Modifications (Older Buildings): Many of the buildings were reported to be old and consequently difficult to modify (e.g., replacing stairs was not an option). Design of Ramps (Stairs Present with No Ramp): Access to buildings was severely limited, as only a small percentage of buildings had entrance ramps. Design of Doors (Lever Use or Push-Pull Doors): Access to buildings was severely limited, as only a small percentage of buildings had automatic door openers.
Hopkins, L. (2011). The path of least resistance: A voice-relational analysis of disabled students' experiences of discrimination in English universities. *International Journal of Inclusive Education, 15,* 711-727.		Design of Ramps (Stairs Present with No Ramp): Physical access to buildings is still a major problem with lack of ramps and steep ramps being common barriers.

Kennedy, M. (2000). Gaining access. *American School & University, 73,* 14-18.	Design of Ramps (Presence of Ramps): Typical equipment upgrades for accessibility includes ramps. Design of Doors (Automatic Doors): Typical equipment upgrades for accessibility includes automatic doors. Minimum requirements for accessibility include at least one accessible doorway to all academic areas. Design of Doors (Undergoing Construction to Widen Existing Door Frames): Typical equipment upgrades for accessibility includes wider doorways.	Design of Ramps (Stairs Present with No Ramp): A common barrier to accessibility includes stairs present with no ramp for access. Design of Doors (Lever Use or Push-Pull Doors): A common barrier to accessibility includes requiring assistance to open doors (primarily an issue prior to the introduction of the ADA)
Kennedy, M. (2005). Planning for inclusion. *American School & University, 78,* 20-26.	Design of Ramps (Presence of Ramps): It is not uncommon to see educational facilities outfitted with ramps, in an effort to negate the obstacles that prevent people with disabilities from using the facilities with ease. Design of Ramps (Presence of Platform Lifts): The district of San Francisco will make improvements to make the main entrance accessible, including installing platform lifts in areas where ramps are not feasible. Design of Entrance Locations (Multiple Accessible Entrances): All buildings that house student programs, services and	Design of Ramps (Stairs Present with No Ramp): The San Francisco school district's ADA Transition Plan spells out needed action in the area of ramps and stairs. The goal is transparent accessibility. Ramps are common ways to make a building accessible, but those modifications may not blend in with the overall design of a facility and tend to call attention to themselves and the people who need them.

	activities will have at least one entrance per building that is accessible to all students with disabilities. Design of Doors (Automatic Doors): Buildings are much easier to enter and exit when automatic door openers are present.	
Kim, M., & Williams, B. (2012). Lived employment experiences of college students and graduates with physical disabilities in the United States. *Disability & Society, 27,* 837-852.		Design of Ramps (Stairs Present with No Ramp): Inaccessible campuses include areas where there are stairs present and no access ramps for wheelchair users.
Lane, K., Swartz, S., & McNair, J. (1993). Implications of special education on school design: Practicality, not theory. *Educational Facility Planner, 31,* 6-9.	Design of Ramps (Presence of Ramps): The construction of ramps to bypass steps and cut-outs in curbing to allow wheelchair access is an absolute necessity to enable students to reach the doors of facilities. Ramps should also be outfitted with non-slip surfaces. Design of Entrance Locations (Multiple Accessible Entrances): Campus buildings must have at least one entrance at each on-grade floor level to be considered accessible. Design of Entrance Locations (Barrier-Free Pathways to Entrances): The pathways leading to [accessible entrances] must be at least 36 inches wide and have available passing space.	Design of Doors (Heavy Doors): Interior doors that have opening force requirements of more than 5 pounds are considered inaccessible. Design of Doors (Lever Use of Push-Pull Doors): Door handles and locks that cannot be easily operable with one hand are considered inaccessible.

Loinsky, L., Levi, T., Saffey, K., &Jelsma, J. (2003). An investigation into the physical accessibility to wheelchair bound students of an institution of higher education in South Africa. *Disability and Rehabilitation, 25,* 305-308.		Design of Ramps (Stairs Present with No Ramp): Two of the buildings were completely inaccessible because all possible entrances to the lecture venues could only be accessed by stairs.
Murphy, D., & Murphy, J. (1997). Enabling disabled students. *NEA Higher Education Journal, 13,* 41-52.		Design of Ramps (Stairs Present with No Ramp): A barrier to accessibility may include the presence of stairs. Design of Doors (Heavy Doors): A barrier to accessibility may include a heavy door, or one that closes too quickly.
Nelson, P. (1996). Library services for people with disabilities: Results of a survey. *Bulletin of the Medical Library Association, 84,* 397-401.	Design of Doors (Undergoing Construction to Widen Existing Door Frames): Modifications to entryways were mentioned by approximately 25% of respondents.	
O'Connor, U., & Robinson, A. (1999). Accession or exclusion? University and the disabled student: A case study of policy and practice. *Higher Education Quarterly, 53,* 88-103.	Design of Ramps (Presence of Ramps): Minor construction work is normally resource-led and can include the installation of ramps.	Design of Doors (Heavy Doors): Heavy fire doors with no low level vision panel were mentioned as making movement more, rather than less, treacherous. Design of Ramps (Stairs Present with No Ramp): Steps at the main entrance was one of the biggest problems.
Pitt, V., & Curtin, M. (2004). Integration versus segregation: The experiences of a group of disabled students moving from mainstream school into special needs further education. *Disability & Society, 19,* 387-401.		Design of Entrance Locations (Absent or Poorly Located Entrances): Entrances for wheelchair users were found at the back of the mainstream college, segregated from the main entrance.

Russell, D., &Demko, R. (2005). *Accommodating learners with disabilities in post-secondary education in Alberta: A review of policies, programs, and support services.* Retrieved from http://eae.alberta.ca.proxy1.lib.uwo.ca/media/134909/aldpss.pdf.		Design of Ramps (Stairs Present with No Ramp): While respondents reported being unable to get into a building due to the presence of stairs, challenges can be so much more than this. Other challenges may include dealing with stress, chronic fatigue, and chronic pain on a daily basis.
Salmon, J. (2011). Universal design for academic facilities. *New Directions for Student Services, 134,* 13-20.	Design of Entrance Locations (Multiple Accessible Entrances): Multiple avenues to enter campus buildings should be provided. All entrances should be wheelchair accessible. This will not only assist students in wheelchairs, but also students with bicycles and others with differing levels of function. Design of Doors (Automatic Doors): Installing sensor-activated automatic doors may assist students with disabilities.	
Samson, S. (2010). Best practices for serving students with disabilities. *Reference Services Review, 39,* 260-277.	Design of Ramps (Presence of Ramps): 75% of the libraries were retrofitted for accessibility, which included compliant ramps. Design of Entrance Locations (Multiple Accessible Entrances): 75% of libraries were retrofitted for accessibility, which included multiple entryways that included one with universal design. All of the libraries provided an accessible point of entry that was used by others entering the building.	

	Design of Entrance Locations (Barrier-Free Pathways to Entrances): The first step to physical access is the reasonable accommodation of getting to the library, which includes a direct pathway to the entrance that is accessible. Design of Doors (Presence of Doors): Power doors and a barrier-free lobby should be available in the library to greet patrons.	
Shevlin, M., Kenny, M., & McNeela, E. (2004). Participation in higher education for students with disabilities: An Irish perspective. *Disability & Society*, *19*, 15-30.		Design of Ramps (Stairs Present with No Ramp): Some blocks within the university complex are not wheelchair friendly, as there are stairs everywhere and no ramps available. Design of Doors (Heavy Doors): Some blocks within the university complex are not wheelchair friendly, as there are heavy double doors required for entry.
Simonson, S. (2012). *Measuring perceived accessibility of students with disabilities at a public university.* (Unpublished doctoral dissertation). Colorado State University, Fort Collins, Colorado.		Design of Doors (Lever Use of Push-Pull Doors): Students had trouble traversing campuses, with the main problems being the lack of automatic door openers and difficulty accessing automatic door openers. Issues were found in relation to building entrances, mainly due to the type of doors used. Design of Entrance Locations (Absent or Poorly Located Entrances): Students had

		issues with poor locations for handicapped entrances. Design of Doors (Narrow Door Widths): Issues were found related to inaccessible doors, due to narrow door widths.
Singh, D. (2003). Students with disabilities and higher education. *College Student Journal, 31,* 367-378.		Design of Ramps (Stairs Present with No Ramp): Only 10% of the institutions of higher learning were considered structurally accessible, as the presence of entrance ramps was very limited. Design of Doors (Lever Use or Push-Pull Doors): Only 10% of the institutions of higher learning were considered structurally accessible, as the presence of automatic doors was very limited.
Smyser, M. (2003). Accessibility: Maximum mobility and function. *American School and University Magazine,* 24-28.	Design of Doors (Automatic Doors): Since doors are required to have a maximum opening force of less than 5 pounds, the best solution is to install powered door openers. Emergency exit doors must have automatic door openers that have a hold-open function to allow a person in a wheelchair to push themselves in prior to the door closing.	
Soorenian, A. (2013). Housing and transport: Access issues for disabled international students in British universities. *Disability and Society, 28,* 1-14.	Design of Doors (Automatic Doors): Students tended to be more satisfied with their experiences on campus when there were automatic doors available for use.	Design of Doors (Heavy Doors): Common complaints from students on campus tended to include the presence of heavy doors.
Taylor, M. (2004). Widening participation into higher education for disabled students.		Design of Ramps (Stairs Present with No Ramp): One student had to be carried up

Education & Training, 46, 40-48.		steps to a pre-admission interview as there was no disabled access. Design of Doors (Heavy Doors): Heavy doors can make entire areas unreachable.
Tinklin, T., & Hall, J. (1999). Getting round obstacles: Disabled students' experiences in higher education in Scotland. *Studies in Higher Education, 24,* 183-194.	Design of Ramps (Presence of Ramps): Ramps were available for entry into all campus buildings.	
US Department of Justice. (2009). *A guide to disability rights laws.* Retrieved from http://www.ada.gov/ cguide.htm.		Construction to Undergo Accessibility Modifications (Older Buildings): Title II of the ADA states that the government is required to follow specific architectural standards in the construction and alteration of new buildings. They must also relocate programs or provide access in inaccessible older buildings.
Wernsman, M. (2008). *The process of designing and constructing an accessible residence hall for people with disabilities on a public university campus*. (Unpublished doctoral dissertation). Colorado State University, Fort Collins, Colorado.	Design of Doors (Undergoing Construction to Widen Existing Door Frames): The width of all doors has been adjusted from the once common 32 inches wide to a new campus standard of 36 inches wide. Design of Ramps (Presence of Ramps): Designers for Summit Hall made a conscious decision to make all exterior doors step-free by providing ramping at all entry points. Design of Doors (Automatic Doors): Main exterior doors are equipped with automatic door operators activated by push buttons.	Design of Entrance Locations (Absent or Poorly Located Entrances): Not all entrances are accessible and therefore some students may have to go through a back or side entrance that is accessible.

West, M., Kregel, J., Getzel, E., Zhu, M., Ipsen, S., & Martin, E. (1993). Beyond section 504: Satisfaction and empowerment of students with disabilities in higher education. *The Exceptional Parent, 59*, 456-467.		Construction to Undergo Accessibility Modifications (Older Buildings): A substantial portion of students were reasonably or very satisfied with physical accessibility of new construction, but only a small percentage were satisfied with retrofitted buildings. Design of Entrance Locations (Absent or Poorly Located Entrances): Architectural barriers for students with physical disabilities may include long distances between handicapped entrances in buildings. Design of Doors (Lever Use or Push-Pull Doors): Architectural barriers for students with physical disabilities may include a lack of automatic door openers at the front entrances of buildings.

Appendix I: Design, Construction and Building Products and Technology for Gaining Access to Facilities Inside Buildings for Public Use (ICF Category- e1501)

References	Facilitators to Physical Accessibility	Barriers to Physical Accessibility
Adam, D., Cornelisse, D., Harding, J., Zambon, J., Baptiste, S. & Steggles, E. (2008). Occupational therapy: Paving the way for accessibility on campus. *Occupational Therapy Now, 10*, 13-15.	Accessible Washrooms: Making washrooms more open to accommodate wheelchairs. Accessible Classrooms: Making classrooms more open to accommodate wheelchairs. Accessible Libraries: Making libraries more open to accommodate wheelchairs.	Limited Availability of Elevators: The volunteers identified and discussed challenges that they encountered while pursuing their education on campus. We also participated with the volunteers in campus walk-abouts, which proved to be a powerful mechanism of barrier identification around campus. Key issues that emerged included barriers related to elevators.
Alrashidi, A. (2010). *University education and students' perceptions of physical disabilities at Kuwait university*. (Doctoral dissertation). Retrieved from ProQuest. (3444468).	Elevators and Lift Present: There should be call buttons in the hallways that are no higher than 42 inches. There should also be at least 30 by 48 inches of clear space for a person in a wheelchair to reach the controls and use the elevator. An elevator should be present on each floor. Accessible Libraries: Participants demonstrated positive attitudes toward university libraries. 67.9% of participants found photo copy machines and scanners that were easy to reach and use. Accessible Seating: Supplying classrooms with adjustable chairs and desks. Accessible Classrooms: Having auditoriums	Limited Availability of Elevators: Elevators were a commonly mentioned problem for participations with physical disabilities. Participants confirmed that elevators are available but they are always being used by other students, which leads to overcrowding and lack of space. This caused frustration in some students as they had to wait to use the elevator. Inaccessible Classrooms: Some participants found the classrooms crowded and often reported becoming tired while attempting to move around inside of them. Inaccessible Seating: One student stated that "sometimes I sit close to the door because there are no spaces available for wheelchairs and this makes it difficult to see what is on

	supplied with appropriate slopes that do not require the use of stairs. Accessible Washrooms: There was a general consensus that accessible washrooms are available; however, other students often use them.	the board." Stairs Present: Some participants complained about access issues related to auditoriums and multi-level classrooms, typically because there were stairs and no ramps available. Inaccessible Labs: Some participants complained that lab chairs and tables were too high to use. In addition, in computer labs, there often were no computers reserved for individuals with disabilities and therefore these students had to wait for an accessible computer to become available. Lack of Rest Areas: Important to have rest areas in main hallways.
Barth, B. (2006). *Facing challenges on campus: The experiences of postsecondary students with disabilities*. (Unpublished doctoral dissertation). The University of Manitoba, Winnipeg.		Limited Availability of Accessible Washrooms: Students often reported that the washroom stalls were too narrow to fit a wheelchair through.
Borland, J., & James. S. (1999). The learning experience of students with disabilities in higher education: A case study of a UK university. *Disability & Society, 14*, 85-101.		Inaccessible Seating: Fixed rigid seats are difficult for some students. Inaccessible Classrooms: None of the buildings are totally adapted for wheelchair users and some areas are especially difficult to access, including lecture halls and seminar rooms.

		Limited Availability of Accessible Washrooms: None of the buildings are totally adapted for wheelchair users and some areas are especially difficult to access, including washrooms. Stairs Present: Stairs pose a barrier in some buildings that are not totally adapted. Limited Availability of Elevators: When no elevators are present, it makes accessing certain areas difficult.
Canadian Council on Learning. (2009). *Strategies for overcoming barriers to training and education for Canadians with disabilities.* Ottawa, ON: Canadian Council on Learning.		Inaccessible Classrooms: The first main barrier encountered by learners with disabilities was physical accessibility. Issues tended to include inaccessible buildings and classrooms.
Chard, G., & Couch, R. (1998). Access to higher education for the disabled student: A building survey at the University of Liverpool. *Disability & Society, 13,* 603-623.	Accessible Classrooms: The older buildings on campus have maintained many of their original exterior features, but have been updated and now provide modern and accessible tutorial, seminar, and workshop rooms. Accessible Washrooms: Older buildings have been updated to provide modern and accessible washrooms.	Limited Availability of Accessible Washrooms: Accessible toilets are not always available for use. There are no accessible toilets on each floor, or even in each building on campus. Even when an accessible toilet is available, there may not be enough room to transfer from the wheelchair to the toilet. Inaccessible Lockers: Lockers are often only available down a flight of 12 stairs. Stairs Present: Lockers are often only available down a flight of 12 stairs.

		Limited Availability of Elevators: Inoperable elevators or elevators that have doors that close too quickly are challenging for students with disabilities.
Cooper, L. (2012). *Disability as diversity: Assessing the perceptions of students with physical disabilities regarding access and equal opportunity in postsecondary education*. (Unpublished doctoral dissertation). George Washington University, Washington. D.C.	Accessible Recreation Areas: Descriptive statistics outline the perceptions of students for the availability of the following(with 5=strongly agree, to 1=strongly disagree): recreational events: 4.	Limited Availability of Elevators: Descriptive statistics outline the perceptions of students for the availability of the following (with 5=strongly agree, to 1=strongly disagree): elevators: 1.33. Limited Availability of Accessible Washrooms: Students rated the availability of accessible washrooms as 2.09. Inaccessible Libraries: Students rated the availability of accessible libraries as 1.50. Inaccessible Classrooms: Students rated the availability of accessible classrooms as 1.75.
Dolce, S. (2007). *Being a student: The process of participation by students with mobility limitations at the University of Buffalo*. (Doctoral dissertation). Retrieved from ProQuest. (3244281).	Adequate Lighting: Suggestions for physical enhancement to aid accessibility and mobility include better lighting indoors. Hand Rails on Stairways: Facilitators include railings on the stairways in amphitheatres, lecture halls, and classrooms. Elevators and Lifts Present: Facilitators for getting around buildings and classrooms are having elevators that work in a timely manner.	

	Accessible Locker Rooms: Having lockers to put belongings in so you do not have to carry them helps with getting around. Accessible Doors: Students recommended installing more automatic doors and making sure that all automatic doors work. Accessible Washrooms: Students recommended more accessible bathrooms (e.g., grab bars in all of them and ensuring they are wide enough to fit a wheelchair).	
Gilbert, M. (2013). *Schools make adjustments to comply with updated standards to make campuses more accessible to the disabled*. Retrieved from http://diverseeducation.com/article/51840/#.	Lowered Drinking Fountains: Plans for increasing accessibility at the University of Alaska include lowering water fountains and lowering filtered water bottle filling stations. Accessible Washrooms: Plans include setting aside at least one urinal per washroom for wheelchair users, making some washroom stalls wheelchair accessible, and adding handrails. Elevators and Lifts Present: It would also be beneficial to widen elevator doors and install larger elevators.	
Goode, J. (2007). 'Managing' disability: Early experiences of university students with disabilities. *Disability & Society*, *22*, 35-48.		Inaccessible Seating: Students with physical disabilities are sometimes automatically visible due to issues related to inaccessibility. An example of this includes always having to sit at the front of lecture theatres.

Hadjikakou, K., Polycarpou, V., & Hadjilia, A. (2010). The experiences of students with mobility disabilities in Cypriot higher education institutions: Listening to their voices. *International Journal of Disability, Development and Education, 57*, 403-426.		Limited Availability of Elevators: Students complained that there were no lifts available and therefore classes had to be on the ground floor only. Maintenance of lifts was another issue, as students reported being left stranded and requiring assistance to be carried down stairs. Limited Availability of Accessible Washrooms: Accessible washrooms are often located far from the main lecture rooms. Major complaints were also made about toilets, as the cleaners had turned the washrooms into a storage area.
Hall, J., & Tinklin, T. (1998). *Students first: The experiences of disabled students in higher education*. (Doctoral dissertation). Retrieved from ERIC. (419476).		Inaccessible Doors: Even after a building is adapted, obstacles still remain inside, such as heavy fire doors or doorways that are too narrow. If doors require a push/pull action, they can sometimes be managed with one's feet, but this is undesirable. Doors that are substantially more difficult to open and close are double doors, in which both need to be opened to gain entry. Inaccessible Libraries: Libraries are commonly cited as inaccessible facilities. Once upstairs in the library, the aisles between the bookshelves are too narrow to accommodate a wheelchair. Another problem is that the photocopiers are too high to use from a wheelchair.

		Limited Availability of Elevators: There are lifts present in some libraries to the upper floors, but they are often too small. One student stated that she can use [the lift] but has to reverse out of it because it is not big enough for her to turn her chair around inside.
Hebel, S. (2001). How a landmark anti-bias law changed life for disabled students. *Chronicle of Higher Education, 47,* 23-26.	Lowered Drinking Fountains: Indiana has agreed to improve access to drinking fountains. Lowered Public Telephones: Indiana has agreed to improve access to telephones. Accessible Recreation Areas: The football stadium has modified seating to accommodate 40-50 wheelchairs. Elevators and Lifts Present: Most buildings on campus had at least one elevator except the 124 year old, University Hall.	Inaccessible Seating: A common complaint about the seating in Assembly Hall (where sporting events occur) is that the wheelchair seating is behind the seating for other students, who often stand throughout the game, restricting viewing ability. Inaccessible Recreation Areas: A common complaint about the seating in Assembly Hall (where sporting events occur) is that the wheelchair seating is behind the seating for other students, who often stand throughout the game, restricting viewing ability.
Hill, J. (1992). Accessibility: Students with disabilities in universities in Canada. *The Canadian Journal of Higher Education, 12,* 48-83.		Inaccessible Public Telephones: It was noted that very few buildings have low level telephones. Inaccessible Drinking Fountains: Very few buildings have low level drinking fountains.
Holloway, S. (2001). The experience of higher education from the perspective of disabled students. *Disability & Society, 16,* 597–615.	Elevators and Lifts Present: Adding a chair lift would not cost too much and it would significantly increase the accessibility of some campus facilities (e.g. being able to	Inaccessible Seating: Not being able to sit among other students, but rather having to sit in one place because it is the only place where wheelchairs fit is a divisive

	access seminar rooms that typically have one or two step entrances). Accessible Doors: Adding automatic doors or re-hanging doors to widen doorways could increase accessibility of older buildings. Having to wait outside and enter a lecture hall through the emergency exit when no one else does (due to size of one's wheelchair) is degrading.	experience.
Hopkins, L. (2011). The path of least resistance: A voice-relational analysis of disabled students' experiences of discrimination in English universities. *International Journal of Inclusive Education, 15,* 711-727.		Inaccessible Seating: Fixed rigid seats in lecture theatres are a common barrier. Stairs Present: Something as simple as the number of steps that students have to be able to climb can present a barrier to physical access.
Kennedy, M. (2000). Gaining access. *American School & University, 73,* 14-18.	Elevators and Lifts Present: A typical equipment upgrade for accessibility includes installing elevators. Accessible Washrooms: Minimum requirements for accessibility include one accessible washroom per gender. A typical equipment upgrade is updating washroom fixtures. Lowered Drinking Fountains: Minimum requirements for accessibility include one accessible drinking fountain. This is a typical equipment upgrade for accessibility.	Limited Availability of Accessible Washrooms: Prior to the ADA, washrooms were particularly inaccessible (e.g. faucets were often out of reach, handles were difficult to turn, and stalls that were too narrow). Inaccessible Public Telephones: Public telephones were often too high. Inaccessible Drinking Fountains: Water fountains were previously too high.

	Accessible Doors: A typical equipment upgrade may include wider doorways, automatic doors and levered door handles.	
Kennedy, M. (2005). Planning for inclusion. *American School & University, 78,* 20-26.	Elevators and Lifts Present: It is not uncommon to see educational facilities outfitted with elevators and platform lifts. Accessible Washrooms: Washrooms need to be renovated so at least one accessible washroom for each gender is located within 200 feet of each building's program areas. Accessible washrooms should be large enough in regards to stall size and should include grab bars, an accessible urinal and accessible mirrors. Accessible Doors: People with mobility impairments often express how much easier they can enter and exit buildings that have automatic door openers.	Multi-Level Buildings: Schools with multiple levels are often more inaccessible than single storey buildings. Stairs Present: The San Francisco School district's ADA Transition Plan spells out needed action in more than 20 areas, including the presence of stairs. Other areas are discussed below: Limited Availability of Elevators: Action is needed in the availability of elevators and platform lifts. Inaccessible Doors: Action is needed in the area of accessible doors. Limited Availability of Accessible Washrooms: Action is needed in the area of accessible restrooms. Inaccessible Drinking Fountains: Action is needed in the area of drinking fountains. Inaccessible Public Telephones: Action is needed in the area of public telephones.

		Inaccessible Libraries: Action is needed in the area of libraries. Inaccessible Labs: Action is needed in the area of laboratories. Inaccessible Recreation Areas: Action is needed in the accessibility of sports areas.
Kim, M., & Williams, B. (2012). Lived employment experiences of college students and graduates with physical disabilities in the United States. *Disability & Society, 27,* 837-852.		Inaccessible Libraries: Some items are located on high shelves (e.g. books in the library) and are inaccessible to individuals in wheelchairs who cannot reach without assistance.
Lane, K., Swartz, S., & McNair, J. (1993). Implications of special education on school design: Practicality, not theory. *Educational Facility Planner, 31,* 6-9.	Elevators or Lifts Present: In multilevel buildings with classrooms and/or washrooms on each level, there must elevators or ramps available. Elevator doors must open automatically, and provide at least 5 seconds between a signal and the actual time to begin closing, and remain fully open should be a minimum of 3 seconds. Lowered Drinking Fountains: Drinking fountains should be accessible by an underneath or parallel approach. Lowered Public Telephones: Public telephones should be accessible by an underneath or parallel approach. Accessible Doors: Automatic doors must take at least 3 seconds to move from 70	

	degrees open to 0.3 inches from the latch. Interior doors must have opening force of 5 pounds or less.	
Loinsky, L., Levi, T., Saffey, K., & Jelsma, J. (2003). An investigation into the physical accessibility to wheelchair bound students of an institution of higher education in South Africa. *Disability and Rehabilitation, 25,* 305-308.		Limited Availability of Accessible Washrooms: Even though most of the venues had washroom doors accessible to wheelchairs, only three of the 18 had toilet cubicle doors which were wide enough for wheelchairs to fit though. Alterations to toilet cubicles, working surfaces and lift controls seem to have been overlooked in regards to accessibility.
Mohd-Nor, M., Zulhanif, M., Razak, A., Usman, I., Che-Ani, A., Abdullah, N., & Tahir, M. (2010). Proceedings from 6th W3SEAS International Conference on Energy, Environment, Ecosystems and Sustainable Development 2010: *The university development planning from the aspects of accessibility and circulation: A comparative study of four Malaysian universities*. Timisoara, Romania.		Inaccessible Classrooms: Academic areas were the most accessible on campuses surveyed, but across the surveyed universities only 50-65% of students mobility impairments report access to academic buildings. Inaccessible Recreation Areas: Second to academic areas, recreation areas are reported as accessible, but only to 51-62% of surveyed students.
Murphy, D., & Murphy, J. (1997). Enabling disabled students. *NEA Higher Education Journal, 13,* 41-52.		Inaccessible Seating: Assigning students with disabilities to seating near doorways, the rear of classrooms or in side aisle is undesirable. Inaccessible Libraries: Mobility impairments make library research difficult (e.g., out-of reach bookshelves

		and card catalogues, difficult-to-use microfiche and copy equipment). Stairs Present: A barrier may be stairs. Limited Availability of Elevators: A barrier may be an inoperable elevator, or one with doors that close too quickly. Inaccessible Doors: A barrier may be a heavy door.
National Educational Association of Disabled Students (NEADS). (2010). *Enhancing accessibility in post- secondary education institutions: A guide for disability service providers.* Retrieved from http://www.neads.ca.proxy2.lib.uwo.ca/en/norc/eag/eag_en.pdf.	Accessible Seating: Students with disabilities should be given priority seating (e.g., at the front of the class or near electrical outlets). Accessible Classrooms: Classrooms should be equipped with wheelchair accessible tables and computer workstations. Accessible Labs: Labs should be equipped with wheelchair accessible tables and computer workstations. Accessible Furniture: Classrooms and labs should be equipped with accessible tables and computer workstations. Accessible Washrooms: Accessible washrooms need to be available in various convenient locations across campus.	

	Accessible Recreation Areas: Offer exercise equipment specifically developed for people with disabilities, such as wheelchair accessible equipment and pool lifts. Accessible Doors: To make recreational facilities accessible, provide accessible doors. Elevators and Lifts Present: To make recreational facilities accessible, provide ramps and elevators. Accessible Locker Rooms: To make recreational facilities accessible, provide accessible change rooms. Lowered Drinking Fountains: To make recreational facilities accessible, provide accessible drinking fountains.	
Nelson, P. (1996). Library services for people with disabilities: Results of a survey. *Bulletin of the Medical Library Association, 84*, 397-401.	Accessible Libraries: A survey of Canadian libraries showed that common modifications made were to allow access to computer workstations and washrooms. Elevators and Lifts Present: Modifications to elevators were mentioned by approximately 25% of respondents.	

O'Connor, U., & Robinson, A. (1999). Accession or exclusion? University and the disabled student: A case study of policy and practice. *Higher Education Quarterly, 53,* 88-103.		Limited Availability of Elevators: Although service lifts are being improved and are a valuable aid when functioning, there is a feeling of disregard on the part of the university that disabled students should be forced to use and rely on lifts, as they are frequently located in remote areas. Limited Availability of Accessible Washrooms: The absence of handrails in washrooms was an inconvenience. Multi-Level Buildings: When libraries span multiple levels, it proves to be difficult for some students who are forced to endure lengthy waits, unsuitable lifts and limited movement. Inaccessible Libraries: Because the library is on different levels, it proves to be a difficult area with some students being forced to endure lengthy waits.
Ontario Undergraduate Student Alliance. (2012). *Policy paper: Students with disabilities.* Retrieved from http://www.ousa.ca/wordpress/wp-content/uploads/2012/11/Students-with-Disabilities1.pdf.	Accessible Seating: Reserved seating should be available in an accessible area of each classroom.	
Pitt, V., & Curtin, M. (2004). Integration versus segregation: The experiences of a group of disabled students moving from mainstream school into special needs further		Limited Availability of Elevators: Students chose to attend special education instead of mainstream education, due to difficulties with physical access. Most wheelchair

education. *Disability & Society, 19,* 387-401.		access is limited to the main floor. In addition, students reported low grades due to physical access (e.g., the science lab was on the second floor and there was no elevator available; therefore the student had to be absent from every lab). Inaccessible Classrooms: Students were unable to access the upstairs classrooms. Inaccessible Libraries: Students were unable to access library facilities that were located above the ground floor. Limited Availability of Accessible Washrooms: Often there was only one accessible toilet, which was located away from the main teaching facilities. Multi-Level Buildings: Labs were on the second floor and students were unable to access them.
Russell, D., & Demko, R. (2005). *Accommodating learners with disabilities in post-secondary education in Alberta: A review of policies, programs, and support services.* Retrieved from http://eae.alberta.ca.proxy1.lib.uwo.ca/media/134909/aldpss.pdf.	Accessible Labs: A common recommendation to post-secondary institutions was to ensure all laboratories, lab stations and equipment are physically accessible so that students with mobility impairments can participate in all lab related activities.	Stairs Present: Respondents reported being unable to get up stairs. Limited Availability of Accessible Washrooms: Respondents reported being unable to get into the washroom in a few of the buildings analyzed.

Salmon, J. (2011). Universal design for academic facilities. *New Directions for Student Services, 134,* 13-20.	Accessible Seating: Options should be provided with regards to accessible seating in classrooms. Movable chairs on a tiered surface, accessed by ramps, allow a wide variety of users to participate in the classroom setting, regardless of size or space needed. Tables in classrooms can be modified. Accessible Furniture: Other ways to enhance accessibility include installing multi-height counters at cafeteria tables and ensuring seating with accessible knee and toe clearance. Accessible Washrooms: Accessibility can be enhanced by installing family washrooms for those who need assistance. Accessible Locker Rooms: Provide private and accessible public showers and lockers.	
Samson, S. (2010). Best practices for serving students with disabilities. *Reference Services Review, 39,* 260-277.	Accessible Libraries: All libraries examined had elevators that provided access to multiple levels. Accessible Doors: A first step towards an accessible library is to provide power doors, and a barrier-free lobby. Make room in aisles for mobility devices that include not only manually operated wheelchairs, walkers, canes, crutches, or braces, but newly adopted scooters, and segways.	Inaccessible Libraries: One library examined did not provide identifiable accessible computers or offer universal access, which eliminates the need to identify specific computers for exclusive use. Access to the entire collection was defined as providing a clear and accessible pathway to all areas of the collection, but did not include the ability to access every shelf within the collection. Two libraries did not provide complete accessibility to their collections based on

	Accessible Furniture: Accessible furniture should be distributed and incorporated throughout the building and into quiet and group study areas, classrooms and computer facilities. This was provided at 87.5% of libraries (e.g. adjustable computer tables, adjustable keyboards, accessible study desks, stand-up study or computer tables, adjustable seating). Elevators and Lifts Present: Elevators need to be installed where ramps are unfeasible. Elevators are common ways to make a building accessible to wheelchair users.	historical placement.
Shevlin, M., Kenny, M., &McNeela, E. (2004). Participation in higher education for students with disabilities: An Irish perspective. *Disability & Society, 19*, 15-30.		Inaccessible Seating: Lack of wheelchair accessible seating in lecture halls is a major issue for students. Inaccessible Classrooms: Lack of wheelchair accessible seating in lecture halls is a major issue for students.
Simonson, S. (2012). *Measuring perceived accessibility of students with disabilities at a public university.* (Unpublished doctoral dissertation). Colorado State University, Fort Collins, Colorado.		Limited Availability of Accessible Washrooms: The general problem is that washrooms are too narrow, are difficult to navigate and are located in poor locations. Inaccessible Recreation Areas: Campus shops and dining halls were areas that were difficult for students to access. Inaccessible Classrooms: Classrooms and auditoriums were common areas that were

		difficult for students to access. The general problem in classrooms was related to furniture arrangement (e.g., few wheelchair accessible desks and desks are too small). Limited Availability of Elevators: There were also complaints about the lack of working elevators or elevators that serviced every floor in a building.
Singh, D. (2003). Students with disabilities and higher education. *College Student Journal, 31,* 367-378.	Elevators and Lifts Present: Structural accessibility takes into consideration the availability of elevators. Accessible Washrooms: Structural accessibility takes into consideration the availability of wheelchair accessible washrooms. Lowered Public Telephones: Structural accessibility takes into consideration the availability of wheelchair accessible payphones. Accessible Classrooms: Structural accessibility takes into consideration the availability of wheelchair accessible classrooms. Accessible Labs: Structural accessibility takes into consideration the availability of wheelchair accessible labs.	

	Accessible Cafeterias: Structural accessibility takes into consideration the availability of wheelchair accessible cafeterias.	
Smyser, M. (2003). Accessibility: Maximum mobility and function. *American School and University Magazine,* 24-28.	Accessible Furniture: Counter heights should have adequate knee space underneath for wheelchair clearance. Accessible Labs: Fume hoods in labs should be accessible for wheelchair access, along with accessible eyewash stations, lowered emergency showers, or showers with handle extensions. Accessible Doors: Doors are required to have a maximum opening force of 5 pounds. The best solution is a powered assisted door opener.	
Tinklin, T., & Hall, J. (1999). Getting round obstacles: Disabled students' experiences in higher education in Scotland. *Studies in Higher Education, 24,* 183-194.		Inaccessible Doors: Once inside buildings, there are often closed fire doors that are difficult, or impossible, to push or pull from a wheelchair. Limited Availability of Elevators: Elevators are often situated far from the accessible entrances and elevators can often be too small. Inaccessible Libraries: Book stacks are too close together to get wheelchairs through them. Photocopiers are often too high to use from a wheelchair.

Wernsman, M. (2008). *The process of designing and constructing an accessible residence hall for people with disabilities on a public university campus*. (Unpublished doctoral dissertation). Colorado State University, Fort Collins, Colorado.		Inaccessible Cafeterias: A common complaint provided by students with physical disabilities about cafeterias is that designers do not pay attention to the ability to get close enough to counters to be able to visually see the food that is being prepared and served. Limited Availability of Elevators: A barrier to physical accessibility in Summit Hall is the fact that there is only one elevator available that must service the 4 storey, 5 wing building. This decision seems to have been driven by inadequate funding (budget driven).
West, M., Kregel, J., Getzel, E., Zhu, M., Ipsen, S., & Martin, E. (1993). Beyond section 504: Satisfaction and empowerment of students with disabilities in higher education. *The Exceptional Parent, 59*, 456-467.		Limited Availability of Elevators: A smaller percentage of students were satisfied with retrofitted buildings. Some issues were no elevators or terrible freight elevators. Inaccessible Labs: Students were not satisfied with inaccessible lab spaces and inaccessible computer labs. Inaccessible Libraries: Issues were related to needing to retrieve books off high shelves at the library. Inaccessible Classrooms: Other barriers included classrooms that were overcrowded with desks and therefore left no room to manoeuvre wheelchairs.

Appendix J: Design, Construction and Building Products and Technology for Way Finding, Path Routing and Designation of Locations in Buildings for Public Use (ICF Category- e1502)

References	Facilitators to Physical Accessibility	Barriers to Physical Accessibility
Adam, D., Cornelisse, D., Harding, J., Zambon, J., Baptiste, S. & Steggles, E. (2008). Occupational therapy: Paving the way for accessibility on campus. *Occupational Therapy Now, 10*, 13-15.		Building Maintenance: The volunteers identified and discussed challenges that they encountered while pursuing their education on campus. We also participated with the volunteer on campus walk-abouts, which proved to be a powerful mechanism of barrier identification around campus. Key issues that emerged included barriers related to pathways, and obstructions on paths.
Alrashidi, A. (2010). *University education and students' perceptions of physical disabilities at Kuwait university*. (Doctoral dissertation). Retrieved from ProQuest. (3444468).	Accessible Signage: Participants suggested providing signs on the restrooms to prevent other students from using them: "Disability signs should be provided for both restrooms and elevators." Clear Pathways: Clear routes of travel should be available in hallways and leading up to the elevator entrances. Measured by: easy to access entrances, stable and firm routes of travel, and wide routes to access main entrance.	Poor Signage: Because no disability signs were posted on the elevators, participants were frustrated by the waiting time for elevators: "There are no signs on elevators say it's for students with disabilities"; "On elevators, there are no signs saying the priority is for us."
Carpenter, S. (1996). The Americans with Disabilities Act: Accommodations in Ohio. *Colleges & Research Libraries, 57*, 555-566.		Poor Signage: Signs were not made visible to persons with disabilities. The typical library responded that it had only one of the five items that comprise the

		signage scale, a mean score of .286. A quarter of the libraries (25%) said they had none.
Chard, G., & Couch, R. (1998). Access to higher education for the disabled student: A building survey at the University of Liverpool. *Disability & Society, 13*, 603-623.		Lack of Accessibility Map: The map published by the university in 1995 does not show the wheelchair route at all, yet there is wheelchair access across the whole campus. The reason the wheelchair route was omitted from the new style map is unclear. Poor Signage: Some buildings still do have problems with access and signage is still being upgraded, most disabled students and visitors find the wheelchair route an essential piece of information. Narrow Hallways and Paths: Hallway widths that were less than 1200 mm at the narrowest point were barriers to students with mobility impairments. Travel Time: Everything took much longer, often because the wheelchair route involved a detour or lack of adequate signs meant doubling back on routes.
Gilson, S., & Depoy, E. (2011). The intersection of spatial design, architecture, and cultural policy in university communities. *Disability and Community Research in Social Science*		Building Maintenance: Interviews of diverse students on campuses revealed a concern with building and navigation maintenance in particular.

and Disability, 6, 27-47.		
Goode, J. (2007). 'Managing' disability: Early experiences of university students with disabilities. *Disability & Society, 22,* 35-48.	Inclusive Accessibility Map: At the time of this research there were 16 projects funded by the 'Disability Premium' fund, including the production of an inclusive campus map.	
Hadjikakou, K., Polycarpou, V., & Hadjilia, A. (2010). The experiences of students with mobility disabilities in Cypriot higher education institutions: Listening to their voices. *International Journal of Disability, Development and Education, 57,* 403-426.		Narrow Hallways and Paths: Some places within some newly-built universities (e.g. halls, toilets, rooms) are inaccessible.
Hopkins, L. (2011). The path of least resistance: A voice-relational analysis of disabled students' experiences of discrimination in English universities. *International Journal of Inclusive Education, 15,* 711-727.		Lack of Accessibility Maps: Physical access to rooms, buildings and libraries is still a major problem with a lack of maps being a common occurrence.
Kennedy, M. (2000). Gaining access. *American School & University, 73,* 14-18.	Clear Pathways: Minimum requirements for physical accessibility include accessible paths of entry to all common areas and elimination of safety hazards along paths.	Lack of Accessibility Maps: Some campuses lack maps to show students accessible routes around campus.
Kennedy, M. (2005). Planning for inclusion. *American School & University, 78,* 20-26.	Inclusive Accessibility Maps: Berkeley also has created a campus map on the Internet where students can locate where pertinent accessible features can be found—the gradient of a street, accessible entrances and curb cuts.	

	"There's nothing more discouraging than getting up a hill and finding there are no curb cuts," says Hawthorne. The mapping system also can show features inside a building, such as where accessible restrooms are located. Accessibility Signage: The university will install a new signage system that designates accessible paths.	
Murphy, D., & Murphy, J. (1997). Enabling disabled students. *NEA Higher Education Journal, 13,* 41-52.		Narrow Hallways and Paths: A barrier may be narrow walkways or aisles.
National Educational Association of Disabled Students (NEADS). (2010). *Enhancing accessibility in post-secondary education institutions: A guide for disability service providers.* Retrieved from http://www.neads.ca.proxy2.lib.uwo.ca/en/norc/eag/eag_en.pdf.	Inclusive Accessibility Maps: It is beneficial to provide campus maps that contain a detailed breakdown of which buildings and classrooms are fully or partially accessible. If all washrooms are not made accessible, it is important to ensure that the locations of the accessible washrooms can be made readily available.	
Nelson, P. (1996). Library services for people with disabilities: Results of a survey. *Bulletin of the Medical Library Association, 84*, 397-401.		Narrow Hallways and Paths: The least common physical modifications were to stack aisle widths.

O'Connor, U., & Robinson, A. (1999). Accession or exclusion? University and the disabled student: A case study of policy and practice. *Higher Education Quarterly, 53,* 88-103.		Travel Time: Steps at the main entrance to buildings were a problem, and once inside ten of the respondents did experience some degree of difficulty travelling quickly enough between classes.
Salmon, J. (2011). Universal design for academic facilities. *New Directions for Student Services, 134,* 13-20.	Wide Aisles: To increase accessibility, yardsticks can be provided to bookstore managers to ensure that aisles and hallways are wide enough to accommodate wheelchairs.	
Samson, S. (2010). Best practices for serving students with disabilities. *Reference Services Review, 39,* 260-277.	Clear Pathways: Accessible pathways leading directly to an accessible entrances and barrier-free lobbies. Maps Located Inside Buildings for Navigation: Immediate information on how to locate spaces in the library should greet patrons in the lobby. Accessible Signage: Signage to direct those who need it to individuals who can provide research assistance and locate elevators, accessible equipment and accessible washroom facilities.	
Tinklin, T., & Hall, J. (1999). Getting round obstacles: Disabled students' experiences in higher education in Scotland. *Studies in Higher Education, 24,* 183-194.		Narrow Aisles in Libraries: In libraries, book stacks are often located too close together and therefore there is not enough space for wheelchairs to move between and around them.

Appendix K: Design, Construction, and Building Products and Technology for Gaining Access to Facilities in Buildings for Private Use (ICF Category- e1551)

References	Facilitators to Physical Accessibility	Barriers to Physical Accessibility
Barth, B. (2006). *Facing challenges on campus: The experiences of postsecondary students with disabilities*. (Unpublished doctoral dissertation). The University of Manitoba, Winnipeg.		Poor Furniture Design: Campus residence fridges are too low, so students have to kneel down on their knees to be able to get something. Some students are not capable of doing this and therefore, must ask for assistance. This barrier is a feature of space that prevents access to full participation in society.
Chard, G., & Couch, R. (1998). Access to higher education for the disabled student: A building survey at the University of Liverpool. *Disability & Society, 13*, 603-623.	Accessible Fire Exits: The university's current policy is to have level access to a fire exit.	Narrow Hallways: Hallways that contain obstructions can reduce physical access.
Cooper, L. (2012). *Disability as diversity: Assessing the perceptions of students with physical disabilities regarding access and equal opportunity in postsecondary education*. (Unpublished doctoral dissertation). George Washington University, Washington. D.C.	Modified Housing and Dorm Rooms: Residential living accessibility takes into consideration the availability of wheelchair accessible rooms. Descriptive statistics outline the perceptions of availability of the following (with 5=strongly agree, to 1=strongly disagree): modified housing: 5. Modified Laundry Facilities: Residential living accessibility takes into consideration the availability of laundry facilities. Descriptive statistics outline the perceptions of availability of the following (with 5=strongly agree, to 1=strongly disagree):	Inaccessible Washrooms: Descriptive statistics outline the perceptions of availability of the following (with 5=strongly agree, to 1=strongly disagree): accessible restrooms: 2.09.

	laundry facilities: 4.8. Accessible Washrooms: Residential living accessibility takes into consideration the availability of accessible bathrooms. Accessible Dining Halls: Residential living accessibility takes into consideration the availability of accessible dining areas. Accessible Fire Exits: Residential living accessibility takes into consideration the availability of fire exits, emergency alert devices and evacuation plans.	
Gilbert, M. (2013). *Schools make adjustments to comply with updated standards to make campuses more accessible to the disabled*. Retrieved from http://diverseeducation.com/article/51840/#.	Accessible Furniture Design: The University of Miami is retrofitting buildings built in the 1800's by modifying student rooms. Modifications include adding handrails and adjusting closet poles as requested. Technology: The use of technology to allow access for wheelchair users is also growing. For example, a new WiFi system using a keycard with a microchip and a receiving pad will allow wheelchair users to unlock their room door as they approach it.	
Gilson, S., & Depoy, E. (2011). The intersection of spatial design, architecture, and cultural policy in university communities. *Disability and Community Research in Social Science and Disability, 6*, 27-47.		Poor Furniture Design: Most areas on campus had standard furniture proportions (e.g., seating, desks and table heights). Poor Furniture Placement: Most areas on campus had standard furniture placements.

		This contributes to the isolation-integration paradox experienced by students with disabilities. Inaccessible Washrooms: The authors found a continuum of exclusion throughout campus, which included inaccessible sanitary facilities.
Goode, J. (2007). 'Managing' disability: Early experiences of university students with disabilities. *Disability & Society, 22,* 35-48.	Modified Housing and Dorm Rooms: All residential accommodations had one adapted room for wheelchair users and a bungalow that was adapted for wheelchair users who require personal assistance.	
Hopkins, L. (2011). The path of least resistance: A voice-relational analysis of disabled students' experiences of discrimination in English universities. *International Journal of Inclusive Education, 15,* 711-727.		Inaccessible Dorm Rooms: Students are often restricted to choosing universities that have on-campus residences that are fully accessible.
Kennedy, M. (2005). Planning for inclusion. *American School & University, 78,* 20-26.	Modified Housing and Dorm Rooms: All buildings that house student services will have at least one accessible entrance. Accessible Washrooms: Restrooms will be renovated so that at least one accessible restroom for each gender will be available. Grab bars can also be installed. Other adaptations to enhance accessibility may include installation of an accessible urinal, mirrors installed at an accessible height, etc.	Inaccessible Dorm Rooms: The San Francisco's school districts ADA transition plan spells out much needed action in relation to alarm systems and areas of rescue assistance.

National Educational Association of Disabled Students (NEADS). (2010). *Enhancing accessibility in post- secondary education institutions: A guide for disability service providers.* Retrieved from http://www.neads.ca.proxy2.lib.uwo.ca/en/norc/eag/eag_en.pdf.	Modified Housing and Dorm Rooms: For colleges and universities with multiple campuses and residences, it is important to offer accessible rooms in all locations. This ensures that students with disabilities are able to be accommodated in a location that is more convenient to their educational needs. This also promotes inclusion, by not segregating students with disabilities in certain locations. Reserved Spaces for Students with Disabilities: Reserve accessible residence space for students with disabilities and provide assistance services to ensure that students with disabilities can fully participate in residence life. It may also be important to consider allowing students with severe disabilities to remain living on-campus throughout the entire year, and the entire duration of their program.	
Russell, D., & Demko, R. (2005). *Accommodating learners with disabilities in post-secondary education in Alberta: A review of policies, programs, and support services.* Retrieved from http://eae.alberta.ca.proxy1.lib.uwo.ca/media/134909/aldpss.pdf.		Inaccessible Dorm Rooms: Inadequate housing facilities may mean that students with disabilities cannot attend post-secondary institutions, or it may create long and exhausting commutes. Inaccessible Dining Halls: Architectural barriers must only be removed if they are limiting access to education. This implies that students do not have to have access to the cafeteria within their residence.

Salmon, J. (2011). Universal design for academic facilities. *New Directions for Student Services, 134,* 13-20.	Accessible Dining Halls: Recommend vertical-facing, rather than the typical horizontal-facing merchandise in cafeteria refrigerators. Features added include multi-height counters in the cafeteria areas, and table seating with accessible knee and toe clearance. Modified Housing and Dorm Rooms: Install sensor-activated automatic doors in student residences to assist students with disabilities. Hallways and entrances should also be laid out for wheelchair accessibility. All ground-floor units and all units in buildings with elevators are considered "covered units" and must comply with accessibility guidelines. Accessible Washrooms: Roll-in showers in residences will allow students with mobility limitations to bathe safely and conveniently.	
Simonson, S. (2012). *Measuring perceived accessibility of students with disabilities at a public university.* (Unpublished doctoral dissertation). Colorado State University, Fort Collins, Colorado.		Inaccessible Dorm Rooms: Several areas were found to pose access disabilities for students with disabilities, including dorm rooms. Inaccessible Dining Halls: Several areas were found to pose access disabilities for students with disabilities, including dining halls. Inaccessible Washrooms: Several areas were found to pose access disabilities for

		students with disabilities, including washrooms. A common complaint by students with mobility disabilities was a lack of adequate accessible restrooms.
Singh, D. (2003). Students with disabilities and higher education. *College Student Journal, 31,* 367-378.		Inaccessible Dorm Rooms: Accessibility of dorm living considers the availability of wheelchair accessible dorm rooms throughout residence halls. Only 2% of the institutions were deemed to facilitate dorm living for students with orthopaedic limitations. Inaccessible Washrooms: Accessibility of dorm living considers the availability of accessible washrooms. Only 2% of the institutions were deemed to facilitate dorm living for students with orthopaedic limitations. Inaccessible Dining Halls: Accessibility of dorm living considers the availability of accessible dining halls. Only 2% of the institutions were deemed to facilitate dorm living for students with orthopaedic limitations.
Soorenian, A. (2013). Housing and transport: Access issues for disabled international students in British universities. *Disability and Society, 28,* 1-14.	Reserved Space for Students with Disabilities: One student had prearranged accessible accommodations. Modified Housing and Dorm Rooms: One university gave a disabled international student accommodations right next to the	Inaccessible Dining Halls: One student could not cook because she had to go via stairs between the bedroom and the kitchen. Poor Furniture Design: 13 students with dissatisfied with the accessibility of their

	university, which is usually not permitted for students. Accessible Washrooms: 6 participants were satisfied with their accommodations. One student mentioned adapted showers as a reason to be satisfied.	accommodations. One student mentioned that the curtains were too difficult to operate. Inaccessible Dorm Rooms: One student had to move to a nearby town in order to find accommodations on a ground floor level. 7 students stated that they had to move at least twice to different accommodations in order to have their needs met. The physical process of moving is more taxing and impacts their health and energy levels. Narrow Hallways: 13 students with dissatisfied with the accessibility of their accommodations. One student mentioned narrow corridors as a problem.
Tiedemann, C. (2008). Finding America's most disability-friendly colleges. *The Exceptional Parent, 38,* 28-30.	Modified Housing and Dorm Rooms: Berkley University- Residence Program has fully accessible rooms in the residences. Accessible Fire Routes: Wright State University matches a student with a physical disability with a roommate who is not disabled to assist in case of an emergency.	
Wernsman, M. (2008). *The process of designing and constructing an accessible residence hall for people with disabilities on a public university campus*. (Unpublished doctoral dissertation). Colorado State University, Fort Collins, Colorado.	Modified Housing and Dorm Rooms: Accessible rooms are distributed throughout Summit Hall, with 12 single rooms on the first floor and 12 double rooms on the second, third and fourth floors. On each of the four floors, the distribution of accessible	Inaccessible Dining Halls: With respect to cafeterias/dining halls, the new residence does not have one. Students must go across the street, or to another residence. Another noted issue was difficulties with getting close to the counters.

	rooms results in six accessible rooms located on both the east and west sides of the central core. In addition, accessible rooms are located at the beginning of long corridors, radiating from the central core and in close proximity to the elevator. The width of all doors in the new campus residences has been adjusted from the once common 32 inches to a new campus standard of 36. Accessible Furniture Design: Furniture for the new residential buildings was selected with flexibility in mind, as dressers fit comfortably into closers, and drawer bases were designed to go under desks and are freestanding and can be moved. In addition, standard bed heights are adjustable. Other examples of adaptations that have been made in the accessible rooms are lowered closet rods, voice-activated telephones, floor pads that open doors with pressure and voice-activated lights. Accessible Washrooms: Other examples of adaptations that have been made in the rooms are relocation of towel bars and installation of grab bars. Another construction detail revealed was the necessity of incising the floor under each roll-in shower for handicap access.	

West, M., Kregel, J., Getzel, E., Zhu, M., Ipsen, S., & Martin, E. (1993). Beyond section 504: Satisfaction and empowerment of students with disabilities in higher education. *The Exceptional Parent, 59*, 456-467.		Inaccessible Dorm Rooms: Only 45% of respondents were reasonably satisfied with their accommodations. The next buildings on campus should be designed with more input from disabled students than professionals. Respondents with physical disabilities were more likely to reside in their own home, their parents' homes, or a relative's home than were respondents in any other disability category.

Appendix L: Products and Technology of Urban Land Development (ICF Category- e1602)

References	**Facilitators to Physical Accessibility**	**Barriers to Physical Accessibility**
Adam, D., Cornelisse, D., Harding, J., Zambon, J., Baptiste, S. & Steggles, E. (2008). Occupational therapy: Paving the way for accessibility on campus. *Occupational Therapy Now, 10*, 13-15.		Inadequate Designated Accessible Parking Spaces: Key issues that emerged included barriers related to parking.
Alrashidi, A. (2010). *University education and students' perceptions of physical disabilities at Kuwait university*. (Doctoral dissertation). Retrieved from ProQuest. (3444468).	Designated Accessible Parking Spaces: Revising parking policies so that students with mobility impairments have their own spaces marked with the International Symbol of Disability can increase physical accessibility. Other ways of increasing access to parking include installing ramps and posting signs for accessibility.	Inadequate Designated Accessible Parking Spaces: All participants in the study agreed that there were an inadequate number of signs designating parking spaces for students with disabilities. Unpredictable Availability of Accessible Parking Spaces: Accessible parking spots were often occupied by other students. Broken or Uneven Pavements: Other barriers to access include uneven and firm grounds. One student stated "I cannot hold a cup of coffee and travel in my wheelchair as the ground is uneven."

Barth, B. (2006). *Facing challenges on campus: The experiences of postsecondary students with disabilities*. (Unpublished doctoral dissertation). The University of Manitoba, Winnipeg.		Dispersed Campus Layout: Major obstacles included classes in different buildings across campus. Fatigue played a large role as one student felt they were always falling asleep in class and/or late for class because of the distances she had to travel between buildings Inadequate Designated Accessible Parking Spaces: Major obstacles included an inadequate number of accessible parking spaces.
Borland, J., & James. S. (1999). The learning experience of students with disabilities in higher education: A case study of a UK university. *Disability & Society, 14,* 85-101.		Dispersed Campus Layout: University campuses that have dispersed layouts (e.g., buildings are not adjacent) are difficult for individuals with physical disabilities to access. Pathways that are Lengthy, Steep, Narrow, or Have Steps Along Them: Campuses that have lengthy, steep paths are difficult to navigate. Inadequate Lighting on Campus: There is a lack of lights on the campus paths to assist in transportation at night. Inadequate Designated Accessible Parking Spaces: There are not enough disabled parking spaces.

		Unpredictable Availability of Accessible Parking Spaces: There can be problems getting into car parks. You cannot always get a space because everyone else uses them. It's no good if you cannot rely on getting a space.
Chard, G., & Couch, R. (1998). Access to higher education for the disabled student: A building survey at the University of Liverpool. *Disability & Society, 13,* 603-623.	Curb Cuts/Curb Removal: The Center for Accessible Environments publishes information on how individuals can carry out access audits. They consider a range of areas when carrying out an access audit. These include dropped kerbs. Level Pavement: They consider a range of areas when carrying out an access audit. These include level pavements.	Broken or Uneven Pavements: Actual difficulties encountered included broken pavements. Inadequate Designated Accessible Parking Spaces: Actual difficulties encountered included disabled parking spaces that are more than 20 meters away from the main entrance. Unpredictable Availability of Accessible Parking Spaces: Actual difficulties encountered included limited availability of accessible parking. Crossing Roads that Do Not Have Stop Lights: Students complained of having to cross roads that do not have stop lights.
Cooper, L. (2012). *Disability as diversity: Assessing the perceptions of students with physical disabilities regarding access and equal opportunity in postsecondary education*. (Unpublished doctoral dissertation). George Washington University, Washington. D.C.	Designated Accessible Parking Spaces: Structural accessibility is measured by the availability of reserved accessible parking spaces within 40 feet of entrances to buildings. Curb Cuts/Curb Removal: Structural accessibility is measured by the availability of curb cuts.	Inadequate Designated Accessible Parking Spaces: Descriptive statistics outline the perceptions of availability of the following items (with 5=strongly agree, to 1=strongly disagree): reserved and close by parking spaces = 1.57 and 2.14, respectively. Inadequate Curb Cuts: Descriptive

		statistics outline the perceptions of availability of the following (with 5=strongly agree, to 1=strongly disagree): curb cuts = 1.73.
Gilson, S., & Depoy, E. (2011). The intersection of spatial design, architecture, and cultural policy in university communities. *Disability and Community Research in Social Science and Disability, 6*, 27-47.	Concentrated Campus Layout: Buildings located centrally and more prominently should be the most important facilities, and buildings located more peripherally should be less important. Student's views parallel this notion as they believe centralized location of essential buildings is a welcoming feature on campus. In addition, campus layout was an important factor in determining where an institution fell on the integration-isolation continuum. More central layouts with essential buildings and resources (e.g., libraries, classroom buildings and student centres) offer greater intellectual mingling than some urban and rural campuses that are more scattered and fragmented.	
Goode, J. (2007). 'Managing' disability: Early experiences of university students with disabilities. *Disability & Society, 22*, 35-48.	Designated Accessible Parking Spaces: This accessible campus has designated car parking spaces near the majority of the buildings on the three main sites.	Dispersed Campus Layout: The main barrier to physical accessibility is campuses that span large distances and universities that have sub-campuses (e.g., the main campus is located ten miles from sub-campuses).

Hadjikakou, K., Polycarpou, V., & Hadjilia, A. (2010). The experiences of students with mobility disabilities in Cypriot higher education institutions: Listening to their voices. *International Journal of Disability, Development and Education, 57,* 403-426.	Designated Accessible Parking Spaces: One-half of the participants mentioned that the institutions had good access and that they could easily reach the different buildings in the university. Special parking spaces help with physical access.	Inadequate Designated Accessible Parking Spaces: A commonly noted obstacle on campus was an inadequate number of disabled parking spaces (e.g., one university only had two disabled parking spaces). Unpredictable Availability of Accessible Parking Spaces: However, the majority of participants mentioned that these spaces were often occupied by people without disabilities.
Hall, J., & Tinklin, T. (1998). *Students first: The experiences of disabled students in higher education*. (Doctoral dissertation). Retrieved from ERIC. (419476).	Designated Accessible Parking Spaces: Students with mobility difficulties may rely on cars for transport to and around their institutions. This means that being able to park near the entrances of the institution is a necessity.	
Hebel, S. (2001). How a landmark anti-bias law changed life for disabled students. *Chronicle of Higher Education, 47,* 23-26.		Curb Cut/Curb Removal: A major barrier to accessibility is funding, as shown by the cost of a single curb cut (which ranges from $100 to $500).
Hopkins, L. (2011). The path of least resistance: A voice-relational analysis of disabled students' experiences of discrimination in English universities. *International Journal of Inclusive Education, 15,* 711-727.		Dispersed Campus Layout: One of the greatest difficulties is having to travel long distances between teaching rooms.
Kennedy, M. (2000). Gaining access. *American School & University, 73,* 14-18.	Curb Cuts/Curb Removal: Minimum requirements for accessibility include curb	Inadequate Designated Accessible Parking Spaces: Parking was consistently cited as a

	cuts.	barrier on campus as there were not enough handicapped spaces and they were often located far away from the entrances to buildings.
Kennedy, M. (2005). Planning for inclusion. *American School & University, 78*, 20-26.	Designated Accessible Parking Spaces: It's not uncommon to see education facilities outfitted with special parking spaces, in an effort to negate the obstacles that prevent people with disabilities from using the facilities with ease. Curb Cuts/Curb Removal: It's not uncommon to see education facilities outfitted with curb cuts, in an effort to negate the obstacles that prevent people with disabilities from using the facilities with ease.	Temporary Conditions: Temporary conditions, such as construction sites, may create unanticipated barriers.
Loinsky, L., Levi, T., Saffey, K., & Jelsma, J. (2003). An investigation into the physical accessibility to wheelchair bound students of an institution of higher education in South Africa. *Disability and Rehabilitation, 25,* 305-308.	Designated Accessible Parking Spaces: All venues had wheelchair parking bays 50 meters from their entrances.	Dispersed Campus Layout: Wheelchair bound students traveled a mean total of 1225 meters per day compared to 1028 meters. Wheelchair bound students had to travel a mean distance of 402 meters between lecture theatre changeover, which was 66 meters further than ambulant students. Programs should be restructured so as to minimize the distance traveled between lectures for wheelchair bound students, and the use of specific lecture venues should be reviewed and changed if necessary.

Mohd-Nor, M., Zulhanif, M., Razak, A., Usman, I., Che-Ani, A., Abdullah, N., & Tahir, M. (2010). Proceedings from 6th WSEAS International Conference on Energy, Environment, Ecosystems and Sustainable Development 2010: *The university development planning from the aspects of accessibility and circulation: A comparative study of four Malaysian universities*. Timisoara, Romania.	Concentrated Campus Layout: Campus layout structure affects the pattern of life on campus, especially in terms of accessibility and circulation. The main facilitator to physical accessibility is a compact arrangement of campus buildings (e.g., more buildings on less land, which reduces the distance between students' accommodation areas and academic areas, and multiple buildings that provide the same amenities). Covered Walkways: Covered walkways that connect the entire campus are also a facilitator to physical accessibility.	
Murphy, D., & Murphy, J. (1997). Enabling disabled students. *NEA Higher Education Journal, 13,* 41-52.		Pathways that are Lengthy, Steep, Narrow, or Have Steps Along Them: Major barriers include narrow walkways and having to take circuitous routes to class due to inaccessibility.

National Educational Association of Disabled Students (NEADS). (2010). *Enhancing accessibility in post- secondary education institutions: A guide for disability service providers.* Retrieved from http://www.neads.ca.proxy2.lib .uwo.ca/en/norc/eag/eag_en.pdf.	Concentrated Campus Layout: For colleges and universities with multiple campuses and residences, it is important to offer accessible rooms in all locations so that students with disabilities are able to be accommodated in a location that is most convenient to their educational needs. Designated Accessible Parking Spaces: Accessible parking spaces should be available at various locations across campus, including residences, social and recreational areas and academic buildings.	
Samson, S. (2010). Best practices for serving students with disabilities. *Reference Services Review, 39,* 260-277.		Inadequate Accessible Parking Spaces: Disability parking near the library was problematic at the other four (50%). Problematic was defined as distances greater than one-fourth of a mile from the entrance to the library. One library was considered inaccessible as it had disability parking but it was located behind the building.
Salmon, J. (2011). Universal design for academic facilities. *New Directions for Student Services, 134,* 13-20.	Accessible Pathways: Modifications that would increase physical accessibility include creating at least one accessible route to every building on campus (in addition to the several other non-accessible routes available), as this can improve traffic flow and density, while still providing access to the most number of students.	Unpredictable Availability of Accessible Parking Spaces: Inadequate and inconsistent enforcement of handicapped parking spaces can lead to a lack of access.

Shevlin, M., Kenny, M., & McNeela, E. (2004). Participation in higher education for students with disabilities: An Irish perspective. *Disability & Society, 19,* 15-30.		Pathways that are Lengthy, Steep, Narrow, or Have Steps Along Them: Some blocks within the university complex are not wheelchair-friendly (e.g., steps are present but there are no ramps available for use).
Simonson, S. (2012). *Measuring perceived accessibility of students with disabilities at a public university.* (Unpublished doctoral dissertation). Colorado State University, Fort Collins, Colorado.		Inadequate Curb Cuts: Many students with physical disabilities have difficulties with traveling their campus in general, with problem areas being lack of curb cuts and poor location of curb cuts. Broken or Uneven Pavement: Other obstacles include sidewalks that are inadequate for mobility needs, specifically sidewalks that are uneven. Inadequate Designated Accessible Parking Spaces: The main problem area for students was lack of accessible parking.
Singh, D. (2003). Students with disabilities and higher education. *College Student Journal, 31,* 367-378.	Curb Cuts/Curb Removal: Structural accessibility takes into consideration the availability of curb cuts. Designated Accessible Parking Spaces: Structural accessibility takes into consideration the availability of reserved parking spaces within 40 feet of the entrances to buildings.	Unpredictable Availability of Accessible Parking Spaces: However, designating parking spaces for disabled drivers does not necessarily guarantee that non-disabled drivers will leave those spaces free. Students with mobility difficulties are sometimes faced with extended journeys to get to the one 'accessible' entry.
Smyser, M. (2003). Accessibility: Maximum mobility and function. *American School and University Magazine,* 24-28.	Designated Accessible Parking Spaces: Every parking lot must have accessible parking spaces for students and visitors. In addition, buildings must be accessible from	Inadequate Curb Cuts: Access to the facility must be addressed in such a manner that students can easily move from parking lots and loading zones without

	the parking spaces. Disability parking near the library was available at four (50%) of the institutions. In almost all cases, facility service parking spaces were conveniently located near each building, indicating that motor vehicles did have physical access.	barriers such as curbs. Pathways that are Lengthy, Steep, Narrow, or Have Steps Along Them: Barriers may include steps or long distances.
Soorenian, A. (2013). Housing and transport: Access issues for disabled international students in British universities. *Disability and Society, 28*, 1-14.	Concentrated Campus Layout: Six participants interviewed were satisfied with their accommodations, as they were located in close proximity to the main university buildings.	
Taylor, M. (2004). Widening participation into higher education for disabled students. *Education & Training, 46*, 40-48.		Dispersed Campus Layout: It is ineffective to build new campus buildings in available land spaces, without assessing the functional relationships of different buildings (e.g., academic buildings located in far proximity to the main academic areas).
Tiedemann, C. (2008). Finding America's most disability-friendly colleges. *The Exceptional Parent, 38*, 28-30.	Covered Walkways: A labyrinth of tunnels was built connecting all the major campus buildings and one residence to increase the campus accessibility.	
Tinklin, T., & Hall, J. (1999). Getting round obstacles: Disabled students' experiences in higher education in Scotland. *Studies in Higher Education, 24*, 183-194.	Designated Accessible Parking Spaces: Students with mobility impairments should be guaranteed parking passes. An extra benefit is being permitted to park in the staff lots, as they are typically located more centrally on campus.	
Wernsman, M. (2008). *The process of designing and constructing an accessible residence hall for people with disabilities on a public university campus*.	Concentrated Campus Layout: Centrally located buildings improve campus accessibility. Despite the recent renovations done to make Summit Hall fully accessible,	

(Unpublished doctoral dissertation). Colorado State University, Fort Collins, Colorado.	students with disabilities were continuing to choose Braiden Hall due to its nearness to the geographic and academic heart of the campus. Braiden Hall is the closest residence facility to the student center, library, and most of the academic buildings.	
West, M., Kregel, J., Getzel, E., Zhu, M., Ipsen, S., & Martin, E. (1993). Beyond section 504: Satisfaction and empowerment of students with disabilities in higher education. *The Exceptional Parent, 59,* 456-467.	Designated Accessible Parking Spaces: Facilitators include providing more disabled parking spaces, improving the location of parking lots and enforcing the appropriate use of disabled parking space. Covered Walkways: Tunnels were built so that wheelchairs did not have to go through the snow.	Inadequate Designated Accessible Parking Spaces: Barriers include inadequate parking and poor location of parking lots. Inadequate parking posed a major barrier for gaining access to classes, professors, administrative offices and social events. Dispersed Campus Layout: Barriers include having to travel from building to building and having to cross the highway to gain access to buildings on the other side of campus.

Appendix M: Land Forms (ICF Category- e2100)

References	Facilitators to Physical Accessibility	Barriers to Physical Accessibility
Borland, J., & James. S. (1999). The learning experience of students with disabilities in higher education: A case study of a UK university. *Disability & Society, 14*, 85-101.		Teaching and Learning Spaces in Diverse Areas: Teaching and learning spaces that involve diverse areas such as towns, beaches, farms, forests, archaeological sites, overseas visits and seabeds are particularly difficult for students with physical disabilities to access. More often than not, students with physical disabilities cannot engage in programs that require placement components.
Gilson, C., & Dymond, S. (2012). Barriers impacting students with disabilities at a Hong Kong university. *Journal of Postsecondary Education and Disability, 25*, 103–118.		Hilly Terrain/Steep Inclines: The landscape on Hong Kong Island, being exceedingly hilly and prone to mud slides, presents many challenges for providing physical access to students with mobility impairments. The university was built on a steep hill that contains many different platforms, which are quite inaccessible.
Goode, J. (2007). 'Managing' disability: Early experiences of university students with disabilities. *Disability & Society, 22*, 35-48.		Hilly Terrain/Steep Inclines: The main campus covers a large, hilly, parkland site which can be challenging for some disabled students.
Hebel, S. (2001). How a landmark anti-bias law changed life for disabled students. *Chronicle of Higher Education, 47*, 23-26.		Hilly Terrain/Steep Inclines: A major obstacle for disabled persons is the hilly terrain.

Hill, J. (1992). Accessibility: Students with disabilities in universities in Canada. *The Canadian Journal of Higher Education, 12,* 48-83.		Hilly Terrain/Steep Inclines: Several coordinators at small universities reported specific problems with terrain (e.g., universities being built on steep hills in rural locations).
Hopkins, L. (2011). The path of least resistance: A voice-relational analysis of disabled students' experiences of discrimination in English universities. *International Journal of Inclusive Education, 15,* 711-727.		Hilly Terrain/Steep Inclines: Steep paths are also barriers in higher education facilities. Teaching and Learning Spaces in Diverse Areas: Students with mobility impairments have had difficulty in gaining acceptance to programs such as marine science, forestry or other laboratory-based courses due to the inaccessible nature of placement facilities.
Kennedy, M. (2005). Planning for inclusion. *American School & University, 78,* 20-26.		Hilly Terrain/Steep Inclines: The steep incline of many streets in San Francisco have made compliance with accessibility guidelines more complicated.
Kim, M., & Williams, B. (2012). Lived employment experiences of college students and graduates with physical disabilities in the United States. *Disability & Society, 27,* 837-852.		Teaching and Learning Spaces in Diverse Areas: The following comments concerning geographic accessibility came from two women with cerebral palsy: "I think the hardest thing for me right now is feeling sort of geographically limited because of my disability. So I am sort of reluctant to move to any other city where I don't know what's out there in terms of accessible housing and transportation." "The field I'm going into really requires a lot of international experience, and it is hard for me to find a job in those areas, especially

		doing field work. It's hard to find an accessible place where I can do field work."
Mohd-Nor, M., Zulhanif, M., Razak, A., Usman, I., Che-Ani, A., Abdullah, N., & Tahir, M. (2010). Proceedings from 6th WSEAS International Conference on Energy, Environment, Ecosystems and Sustainable Development 2010: *The university development planning from the aspects of accessibility and circulation: A comparative study of four Malaysian universities*. Timisoara, Romania. Timisoara, Romania.		Hilly Terrain/Steep Inclines: The existence of hilly terrains may have been the major factor as to why the core structure of the campus could not have been planned better.
Salmon, J. (2011). Universal design for academic facilities. *New Directions for Student Services, 134,* 13-20.		Hilly Terrain/Steep Inclines: Universities that are built on hilly terrains often have many stairs and steep ramps that are nearly impossible for students with physical disabilities to use.
Samson, S. (2010). Best practices for serving students with disabilities. *Reference Services Review, 39,* 260-277.	Flat Landscapes: The majority of the libraries were retrofitted for accessible compliance to direct access to the building. These retrofits included flattening of landscapes.	
Tiedemann, C. (2008). Finding America's most disability-friendly colleges. *The Exceptional Parent, 38,* 28-30.	Flat Landscapes: A relatively young school which opened in 1967 was built to be accessible and is quite flat.	

Appendix N: Population Density (ICF Category- e2151)

References	Facilitators to Physical Accessibility	Barriers to Physical Accessibility
Borland, J., & James. S. (1999). The learning experience of students with disabilities in higher education: A case study of a UK university. *Disability & Society, 14,* 85-101.		Crowding: Congested roads pose major barriers for students with physical disabilities.
Gilson, S., & Depoy, E. (2011). The intersection of spatial design, architecture, and cultural policy in university communities. *Disability and Community Research in Social Science and Disability, 6*, 27-47.		Crowding: The authors found a continuum of exclusion present throughout campuses, with one of the main barriers being overcrowding.
Murphy, D., & Murphy, J. (1997). Enabling disabled students. *NEA Higher Education Journal, 13,* 41-52.		Crowding: If the time between classes is short, they may have difficulty negotiating crowded paths.
Simonson, S. (2012). *Measuring perceived accessibility of students with disabilities at a public university.* (Unpublished doctoral dissertation). Colorado State University, Fort Collins, Colorado.		Crowding: Sidewalks can feel particularly narrow in areas with heavy traffic flow, which makes them significantly difficult to navigate.
Taylor, M. (2004). Widening participation into higher education for disabled students. *Education & Training, 46*, 40-48.		Crowding: A major problem for disabled students is navigating crowds in classrooms, hallways, and elevators.

Appendix O: Precipitation (ICF Category- e2253)

References	Facilitators to Physical Accessibility	Barriers to Physical Accessibility
Gilson, C., & Dymond, S. (2012). Barriers impacting students with disabilities at a Hong Kong university. *Journal of Postsecondary Education and Disability, 25,* 103–118.		Rain/Mud: One student found certain areas of campus to be very slippery when it was raining or had recently rained.
Gilson, S., & Depoy, E. (2011). The intersection of spatial design, architecture, and cultural policy in university communities. *Disability and Community Research in Social Science and Disability, 6,* 27-47.		Snow/Ice Build Up: Navigation in ice and snow becomes increasingly difficult for all students, but especially for those who move through space in atypical fashions using assistive devices.
Simonson, S. (2012). *Measuring perceived accessibility of students with disabilities at a public university.* (Unpublished doctoral dissertation). Colorado State University, Fort Collins, Colorado.		Snow/Ice Build Up: Problem areas on campus include lack of snow removal. The general consensus is that sidewalks are not cleared of snow very well in the earlier hours of the day.
West, M., Kregel, J., Getzel, E., Zhu, M., Ipsen, S., & Martin, E. (1993). Beyond section 504: Satisfaction and empowerment of students with disabilities in higher education. *The Exceptional Parent, 59,* 456-467.	Tunnels on Campus: Tunnels were also built so that wheelchairs did not have to go through the snow, as the university is situated within the Snowbelt. Snow Removal: Removing the snow would help students with disabilities to easily navigate the campus.	Snow/Ice Build Up: A major obstacle for wheelchair users is combating the snow to get to class.