DISRUPTING THE NORMS: TOWARDS NEW UNDERSTANDINGS OF PERSISTENCE AND SUCCESS IN POSTSECONDARY EDUCATION

by

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Abstract

The purpose of this research study was to explore longitudinally the academic outcomes and academic pathways of one cohort of students (N=790) in four general business diploma programs within one Ontario college. Informed by a life course perspective and utilizing the visual methodology of sequence analysis with optimal matching and cluster analysis, and discrepancy analysis, using R, the study maps individual student enrolment and achievement patterns beyond the expected time frame for graduation; presents diverse academic achievement measures including total courses enrolled, total courses passed, and course completion rate; and explores relationships between academic achievement measures and academic pathways, and student demographic, prior secondary school academic, and behavioural and academic characteristics related to the student-institution interaction at the time of entry.

The study contributes to the research on postsecondary education student success in three ways. First, findings suggest the historical student success frameworks of Tinto (1975, 1993) and Metzner and Bean (1987) do not adequately represent the diverse academic pathways and outcomes for many students today. Second, the research supports Finnie, Childs, and Qui (2012) that reliance on student group level identification as a predictor of pathway or persistence is of limited use and therefore student success initiatives should be directed at individual students. Third, research findings suggest institutional and system structures and policies such as differentiation of enrolment status and curriculum and tuition fee structure may impede student success, particularly for those students whose lives do not align with the traditional and expected postsecondary education pathway.

Although significant relationships were found between some of the student characteristics and individual academic outcomes and pathways, the effect size of these relationships is too small to be helpful from either a practical or a policy perspective to differentiate in advance students who will be
successful under traditional measures and those who will not. Results suggest that early educational trajectories do not determine later ones and the transition into postsecondary education has the potential to alter prior pathways. The study also highlights the usefulness and challenges of utilizing historical institutional administrative student-level data.
Preface

This dissertation is an original intellectual product of the author, S. Graydon Kelsall. The research reported in Chapters 3, 4, and 5 was covered by UBC Behavioural Research Ethics Certificate H13-0123.
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<tr>
<td>ACCC</td>
<td>Association of Canadian Community Colleges</td>
</tr>
<tr>
<td>CAAT</td>
<td>College of Applied Arts and Technology</td>
</tr>
<tr>
<td>CCL</td>
<td>Canadian Council on Learning</td>
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<tr>
<td>EPI</td>
<td>Educational Policy Institute</td>
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<tr>
<td>EQAO</td>
<td>Education Quality and Accountability Office</td>
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<tr>
<td>ERP</td>
<td>Enterprise Resource Planning</td>
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<tr>
<td>ESL</td>
<td>English as a second language</td>
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<td>FITS</td>
<td>Freshman Integrated and Tracking System</td>
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<tr>
<td>GPA</td>
<td>Grade point average</td>
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<tr>
<td>GTA</td>
<td>Greater Toronto Area</td>
</tr>
<tr>
<td>HEQCO</td>
<td>Higher Education Quality Council of Ontario</td>
</tr>
<tr>
<td>ITAL</td>
<td>Institute of Technology and Advanced Learning</td>
</tr>
<tr>
<td>K-12</td>
<td>Kindergarten to grade 12</td>
</tr>
<tr>
<td>KPIs</td>
<td>Key Performance Indicators</td>
</tr>
<tr>
<td>MOOCs</td>
<td>Massive open online courses</td>
</tr>
<tr>
<td>MTCU</td>
<td>Ontario Ministry of Training, Colleges and Universities</td>
</tr>
<tr>
<td>NSSE</td>
<td>National Survey on Student Engagement</td>
</tr>
<tr>
<td>OCAS</td>
<td>Ontario College Application Service</td>
</tr>
<tr>
<td>OECD</td>
<td>Organisation for Economic Co-operation and Development</td>
</tr>
<tr>
<td>PSE</td>
<td>Postsecondary education</td>
</tr>
<tr>
<td>TDSB</td>
<td>Toronto District School Board</td>
</tr>
<tr>
<td>YITS</td>
<td>Youth in Transition Survey</td>
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To my parents,

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and my sons,

James Kelsall, Geoffrey Kelsall and Drew Kelsall,

with love and appreciation
Chapter One: Introduction

Tom Graydon disembarked from a steamer at the edge of a Montreal quay in 1887, at the age of 21. Trained as a scribe, he left his past in Dublin, Ireland well buried, as those who came after, searching for history, can attest. Tom raised a family in the shadow of McGill University, living in a house on the McGill grounds, working for the university for almost 50 years, initially as a groundsman, later responsible for facilities, and as McGill's first track and field coach. His son Gordon, a carpenter by trade who served in France during World War I, always regretted not completing high school and was strongly committed to his sons attending McGill; which they both did, each graduating with a Bachelor of Engineering degree before marrying and having a family. They grew up knowing that education, including a university degree, came first.

Tom Graydon was my great grandfather, my father's grandfather. My father was, in the parlance of today, a first generation student. My mother, a nurse, whom he met at McGill and who was raised on a farm in Niagara, was also a first generation student.

Their belief in the overriding importance of education passed to the next generation. I grew up knowing I would continue my education after high school; it was part of the landscape of my future. In today's nomenclature, I was a traditional student, on a path to becoming a non-traditional student and lifelong learner, as well as a professional, a partner of a first generation student, a parent, a volunteer, a teacher, and a researcher.

I know education can change the trajectory of a life, because I have seen it and experienced it.

As a result of my close interaction with students over the past decade as a professor and advisor with program responsibilities, I also know that the postsecondary terrain is different today than when I first enrolled. More students have more opportunity and choice, and more competition; financial and career outcomes are less certain and less secure; and tuition and living costs have increased.
more than the wages of summer jobs have, so few students are able to pay their own way with minimal student loans, as I did. Students are more diverse along many parameters, and their lives are more complex; however the structure of the PSE system has not noticeably changed, and the narrative about student success and persistence continues to reflect linear models from the 1970s-1980s, incongruent with divergent individualized student pathways. Offering a new perspective on student postsecondary academic outcomes and pathways, this study seeks to disrupt the accepted norms surrounding student success. To support student postsecondary success broadly the narratives about student success and the institutional structures constituting barriers to student success must change.

Overview

For more than a quarter century conventional wisdom has regarded some form of postsecondary education (PSE) as a prerequisite for individual economic well-being. Provincial governments have promoted greater access to, participation in, and graduation from colleges and universities.

Not all who begin programs complete them. When students enroll in but do not complete PSE, they incur short term financial and opportunity costs. In the long term, such students have fewer educational and career opportunities, lower lifetime earnings and decreased well-being, benefits associated with PSE completion. The public also incurs short and long term costs when students begin but do not finish their postsecondary programs.

Policy discourse on postsecondary student persistence seems dichotomous - focused on the student experience within the educational institution or on student-group-level demographic and other characteristics perceived as related to persistence. Notwithstanding the extensive research devoted to postsecondary student success, there is little understanding of individual student academic pathways within PSE institutions particularly over time periods longer than one year, the
characteristics of students who do persist, or the institutional factors which may support or impede persistence. For example, research related to the heterogeneity of student groups identified by socio-economic status, ethnicity, geographic location, goals, motivation, English language proficiency, academic preparedness, disability or sex does not appear to inform policy regarding persistence. There is little research on how institutional factors such as program or curriculum design, registrar protocols, scheduling or language regarding student success affect persistence.

Informed by a life course perspective, this dissertation examines postsecondary student persistence using historical institutional administrative data to understand the interaction of student and institutional factors related to persistence in the hope of informing institutional, if not provincial, educational policy.

**Background**

Education has long been considered vital from both the human capital and human development perspectives and has become increasingly valued for national and international economic competitiveness and prosperity (Rizvi & Lingard, 2010). As a result, postsecondary education is now seen as key to ensuring that individuals have the knowledge, skills, and capability to fully participate in today’s society and global economy.

Equity in a PSE system goes beyond access and participation; outcomes must also be considered. Equitable tertiary systems are those that ensure that access to, participation in and outcomes of tertiary education are based only on individuals’ innate ability and study effort. They ensure that the achievement of educational potential at tertiary level is not the result of personal and social circumstances, including of factors such as socio-economic status, gender, ethnic origin, immigrant status, place of residence, age, or disability. (Santiago, Tremblay, Basri, & Arnal, 2008, p.14)
Although levels have decreased slightly in recent years (Organisation for Economic Co-operation and Development [OECD], 2012), Canada continues to have one of the highest PSE participation rates in the world (OECD, 2013) largely as a result of the high proportion of students enrolled in community colleges (OECD, 2013; Canadian Education Statistics Council, 2011). Not all students persist to graduation however; when students drop out the private and public costs are significant.

Individual PSE experience is positively related to higher earnings (OECD, 2010b; Statistics Canada, 2008) particularly higher levels of PSE (Boothby & Drewes, 2006; Hango, 2010; Shaienks & Gluszynski, 2009; Walters, 2004; Walters & Frank, 2010) both in the long term (Frenette, 2014) and for youth in the short term (Hansen, 2007). In general, individual economic returns reflect time spent on successive levels of education. Some PSE is more advantageous than none; obtaining a credential is better than not. Graduates receive an earnings premium for additional time devoted to education with a "sheepskin effect" from obtaining a credential (Ferrer & Riddell, 2002, p.880; Riddell, 2003a, p. 21). For Ontario college graduates, starting salaries reflect the length of the college program (Colleges Ontario, 2011a) and expected lifetime earnings, while less than for university graduates, are estimated to be approximately $220,000 higher than for high school graduates. College graduates are also likely to spend less time unemployed than high school graduates (Berger & Parkin, 2009; OECD, 2010b). High school graduation and postsecondary completion are two of the social and human development measurement criteria used by the City of Toronto to identify neighbourhoods prioritized for targeted funding to address issues of poverty (St. Michael's Hospital, 2014).

Public benefits from PSE include increased government revenues from higher income taxes (Berger & Parkin, 2009; Ferrer & Riddell, 2002; Riddell, 2003a); positive intergenerational effects (Riddell, 2003b; Riddell, 2004; Sen & Clemente, 2010); positive health effects; reduced crime; and increased civic engagement (Riddell, 2003b; Riddell, 2004). On a national basis, countries achieve high
performance on the Human Development Index more often through increases in health and education than through economic growth (United Nations Development Programme, 2010).

Although Ontario's PSE system is comprised of a diverse range of both public and private institutions, it is characterized as primarily binary with 24 public colleges and 20 public universities. Distinguished from the system in the United States which was established as vertically binary, with a hierarchy of curriculum and program-related connections between colleges and universities, Ontario's has been described as a system of "horizontal differentiation", with separate institutions for academic and technical learning (Skolnik, 2001, p. 5). Prior to the mid-1960s, student choice of PSE pathway was more limited than today. In 1967, in response to projected increases in the number of students wanting to access PSE and in recognition of the needs of industry for technically trained and educated employees, the Ontario government established the system of colleges of applied arts and technology (CAATs), often referred to as community colleges, throughout the province. Distinct from other jurisdictions, such as British Columbia, Alberta and many U.S. states where colleges were designed to have a significant role in university transfer, and at a time when Ontario universities were focussed primarily on teaching, it was decided that baccalaureate education was to be solely the responsibility of the universities; vocational training the mandate of the colleges (Clark, Moran, Skolnik, & Trick, 2009). It was this differentiation of prescribed accreditation, together with differentiation of funding and governance structures which prompted Skolnik (2001) to identify Canada's (other than British Columbia and Alberta), and implicitly Ontario's PSE system as "among the most pure and unambiguous binary systems in the world" (p. 4).

The mission of the CAATs was to provide accessible, applied learning in career-oriented and vocational programs in subject areas not served by universities. Although at inception the colleges were described as distinct but equal (Skolnik, 2001, p. 4), as a result of their different mandates the two types of institutions have never been perceived as such. From the perspectives of inputs
(student prior academic achievement, institutional resources, faculty qualifications, and funding) and outputs (credentials, research activity, graduate earning capacity) Ontario universities have always had more status; colleges less.

Over time, university missions have shifted from primarily teaching to prioritization of research, teaching, and service; an expensive structure to finance and maintain. This, together with increasing demand for baccalaureate education placed pressure on the Ontario government to provide a broader range of PSE options (Clark et al., 2009). In 2003, five colleges, including Humber College (Humber), the site of this research study, were designated as Institutes of Technology and Advanced Learning (ITALs) and given legislative permission to offer up to 15% of their programming in the form of applied degrees. Concurrent with the expansion of program offerings, there was incremental progress on increasing inter-institutional transferability. As a result, today the binary structure of the Ontario system appears to be less defined and students have more options to transfer from college to university; however, except where specific block transfer agreements have been negotiated, transfer credits at the undergraduate level continue to be approved on a course-by-course basis and are not seamless or guaranteed. College applied degree graduates also face significant barriers in accessing graduate level study within universities.

In the early 1970s, a time when PSE systems in developed countries were expanding significantly, Trow (1973) wrote of the future challenges of moving from elite to mass to universal access PSE; challenges affecting every facet of PSE including student success, and relationships with secondary school and adult education. Trow (1973) suggested problems associated with the transition to universal higher education "can be understood as different manifestations of a related cluster of problems" (p. 1) resulting from growth and expansion. Table 1 displays Trow's conceptualization as summarized by Brennan (2004, p. 23).
Table 1: Trow’s Conceptions of Elite, Mass and Universal Higher Education

<table>
<thead>
<tr>
<th></th>
<th>Elite (0 - 15%)</th>
<th>Mass (16 - 50%)</th>
<th>Universal (over 50%)</th>
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<tbody>
<tr>
<td>i) Attitudes to access</td>
<td>A privilege of birth or talent or both</td>
<td>A right for those with certain qualifications</td>
<td>An obligation for the middle and upper classes</td>
</tr>
<tr>
<td>ii) Functions of higher education</td>
<td>Shaping mind and character of ruling class; preparation for elite roles</td>
<td>Transmission of skills; preparation for a broader range of technical and economic elite roles</td>
<td>Adaptation of 'whole population' to rapid social and technological change</td>
</tr>
<tr>
<td>iii) Curriculum and forms of instruction</td>
<td>Highly structured in terms of academic or professional conceptions of knowledge</td>
<td>Modular, flexible and semi-structured sequence of courses</td>
<td>Boundaries and sequences break down; distinctions between learning and life break down</td>
</tr>
<tr>
<td>iv) The student 'career'</td>
<td>&quot;sponsored&quot; after secondary school; works uninterruptedly until gains degree</td>
<td>Increasing numbers delay entry; more drop out</td>
<td>Much postponement of entry, softening of boundaries between formal education and other aspects of life; term-time working</td>
</tr>
<tr>
<td>v) Institutional characteristics</td>
<td>Homogenous with high and common standards; small residential communities; clear and impermeable boundaries</td>
<td>Comprehensive with more diverse standards; 'cities of intellect' - mixed residential/commuting; boundaries fuzzy and permeable</td>
<td>Great diversity with no common standards; aggregates of people enrolled but rarely or never on campus; boundaries weak or non-existent</td>
</tr>
<tr>
<td>vi) Locus of power and decision making</td>
<td>The Athenaeum' - small elite group, shared values and assumptions</td>
<td>Ordinary political processes of interest groups and party programmes</td>
<td>(The Daily Mail) 'Mass publics' question special privileges and immunities of academe</td>
</tr>
<tr>
<td>vii) Academic standards</td>
<td>Broadly shared and relatively high (in meritocratic phase)</td>
<td>Variable; system/institution 'become holding companies for quite different kinds of academic enterprises'</td>
<td>Criterion shifts from 'standards' to 'value added'</td>
</tr>
<tr>
<td>viii) Access and selection</td>
<td>Meritocratic achievement based on school performance</td>
<td>Meritocratic plus 'compensatory programmes' to achieve equality of opportunity</td>
<td>Open', emphasis on 'equality of group achievement' (class, ethnic)</td>
</tr>
<tr>
<td>ix) Forms of academic administration</td>
<td>Part-time academics who are 'amateurs at administration'; elected/appointed for limited periods</td>
<td>Former academics now full-time administrators plus large and growing bureaucracy</td>
<td>More specialist full-time professionals. Managerial techniques imported from outside academe</td>
</tr>
<tr>
<td>x) Internal governance</td>
<td>Senior professors</td>
<td>Professors and junior staff with increasing influence from students</td>
<td>Breakdown of consensus making institutional governance insoluble; decision-making flows into hands of political authority</td>
</tr>
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</table>

As the proportion of each youth cohort in PSE increases, there is a corresponding heightened policy focus on equity of access and outcomes and PSE participation becomes more an expectation or obligation for young adults, affecting inter alia, institutional size, student motivation, student diversity, student-faculty relationships and the permeability of institutional boundaries. Trow's (1973) conceptualization is now seen as "remarkably prescient" (Brennan, 2004, p. 22). Many aspects of his characterization of mass and universal PSE systems can be seen in the systems of today, including that of Ontario.

In 2009, 50% of Canadians age 25-64 had completed PSE, with variation between the individual provinces and territories (Canadian Education Statistics Council, 2011). More than 60% of that age group in Ontario have at least some PSE; comparable approximate percentages include New Brunswick – 58%, Quebec – 56%, British Columbia – 53%, and Alberta – 49%. The region with the lowest level of PSE participation in Canada is Nunavut with approximately 33% of the population age 25-64 having some PSE (Canadian Education Statistics Council, 2011).

The Ontario PSE system has been described as “near-universal” (Clark et al., 2009, p. 23) based on Trow's (1973) measures of participation and completion. In 2011, almost 65% of Ontario adults age 25-34 had completed some form of PSE (Statistics Canada, 2013). The participation rate for 18-24 year olds was approximately 40% in 2012 and since 2003, Ontario has increased access by 200,000 students (Ontario Ministry of Training, Colleges and Universities [MTCU], 2012) with an additional 60,000 spaces promised by 2015-16 (Ontario Ministry of Finance, 2011).

The growth in student enrolment in the Ontario college sector has been accompanied by profound change in the managerial structures at the institutional level with significantly lower growth in full-time faculty and a large expansion of the administrative complement, as seen in Figure 1. Since the 1996-97 academic year full-time college student enrolment in Ontario has increased by approximately 30%. In comparison, the complement of full-time administrators has increased almost
60%; whereas the number of full-time faculty has increased approximately 10%. The balance of additional teaching demands due to enrolment increases have been met primarily through the hiring of part-time contract instructors.

Figure 1: Changes in Full-Time College Staff and Full-Time Student Enrolment, Indexed to 1996-97

![Graph showing changes in full-time college staff and student enrolment, indexed to 1996-97.](https://example.com/graph.png)

Other facets of the PSE system also reflect Trow's (1973) characterizations of mass and universal systems as summarized by Brennan (2004) including the increased permeability of boundaries between the activities of daily life, work and learning, the prevalence of delayed entry and of attrition, and the prioritization of access and equality of outcomes for disadvantaged groups. PSE policy priorities emphasize student retention and completion, particularly for visible minority, Aboriginal, first generation, rural and other students from groups seen as non-traditional, and typically
underrepresented in PSE (Higher Education Quality Council of Ontario [HEQCO], 2009; Santiago et al., 2008). Academic success is defined relative to outcome measures. Key performance indicators (KPIs) include graduation rates, and value added measures of graduate and employer satisfaction levels, and graduate employment rates. The Ontario government’s stated goal is to increase the postsecondary graduation rate from 62% to 70% (Ontario Office of the Premier, 2010). A widely reported projected mismatch between future labour market needs and the supply of workers with the requisite skills (Miner, 2010) has intensified the focus on student postsecondary success although evidence indicates that no such mismatch currently exists (Bartlett & Lao, 2014; Burleton, Gulati, McDonald, & Scarfone, 2013; Statistics Canada, 2014).

Intergenerational earnings mobility in Canada is higher than in many other OECD countries (Corak, 2006, 2011) and the education system is seen as one factor contributing to this (Corak, Curtis, & Phipps, 2010). Compared to most other OECD countries, Canada’s education system is classified as more open at both the secondary and postsecondary levels, with more general programming and less differentiation between academic and vocational streams (Matějů, Smith, Soukup, & Basl, 2007). Research shows that educational mobility is related to parental socio-economic and cultural background (d’Addio, 2007; Corak, 2011; OECD, 2010a), ethnic origin, and family language in the home, and is influenced by educational policy such as early streaming of students (d’Addio, 2007). According to the OECD (2010a), “education policies play a key role in explaining observed differences in intergenerational social mobility across countries” (p.183).

Although comparatively open, streaming and stratification do exist within Canadian educational systems, affecting student PSE pathways. As noted above, due to the continued strong binary nature of the Ontario PSE system, the initial choice of PSE entry point is important to student pathway and success. Students must choose either a college or university as their initial institution. Although highlighted as a government policy priority, transfer between institutions continues to be
challenging and generally carries financial and opportunity costs related to lost or duplicate credits and prolonged time-to-completion. Ontario colleges attract many students from demographic groups which have not historically accessed PSE, including students from lower socio-economic backgrounds, students with disabilities, students who are recent immigrants and visible minority students. Restricted credit transferability raises the question of whether Ontario colleges operate in part to cool out (Clark, 1960) the ambition and upwardly mobile intentions of students from nontraditional groups, whereby students are encouraged to access PSE via college as a pathway to university by the promise of credit transferability, and are then subsequently blocked from doing so by institutional policies and processes. "[T]he cooling-out process in higher education is one whereby systematic discrepancy between aspiration and avenue is covered over and stress for the individual and the system is minimized" (Clark, 1960, p. 576). Institutional cooling out mechanisms and processes identified by Clark (1960) include unattainable academic standards, streaming into remedial classes and redirection into vocational programs with no subsequent credit transferability to degree level study. As noted by Clark (1960), "while some students of low promise are successful, for large numbers failure is inevitable and structured. The denial is delayed, taking place within the college instead of at the edge of the system" (p. 571).

Brint and Karabel (1989) in their book Diverted Dream, highlight the 1900-1985 transformation of the American community college system from institutions offering liberal arts transfer programs to those providing primarily terminal vocational programs. Brint and Karabel (1989) conclude that this transformed structure did provide a cooling out function (Clark, 1960) and in so doing supported and reproduced existing class inequalities; it was a structure deliberately created by community college leaders and administrators within a constrained system to further their personal and institutional goals of providing education to a niche market, securing the colleges a place in the hierarchy of the American postsecondary landscape. Institutional practices and policies were utilized to this end; for example, counselling students on the practicalities of their program choice, encouraging students to
have realistic goals, and placement testing in support of these practices. Other administrative practices included enrolment quotas on transfer programs and disallowing transfer for credit from vocational programs to transfer programs.

In contrast to the development of the American PSE system, at inception the Ontario college system was designed as an alternate-to-university pathway through PSE and into the work force. With little to no transfer function between the two types of institutions, colleges were not identified or marketed as providing a pathway to university level study, a necessary feature to the existence of a cooling out process within the college system. Without credit transferability to university, one could not argue that colleges attracted students through the offer of a university pathway and then diverted them to a terminal program. If a cooling out structure could be identified in Ontario historically, it was situated within the educational system in the Kindergarten to grade 12 (K-12) levels and/or within society more generally where student aspirations were directed to college instead of university.

The situation today is different and more complex. As the transfer function of colleges has broadened, colleges have increasingly marketed their programs as educational pathways to university. To the extent that credit transferability continues to be restricted, colleges could be seen as a place where student aspirations are cooled out. Arguably, the existence of college degree programs, by expanding student degree completion options may act to offset this tendency; however college degrees also appear to act as terminal programs for the vast majority of students. Whether and to what extent cooling out does occur, would depend on how internal policies, structures and processes are designed – to divert or to support student aspirations, and the actual effect of these policies, structures and processes once implemented, as well as the types of programs offered and the students who access them. Levin (2004) suggests that the introduction of the college baccalaureate degree affects college institutional mission and identity as the composition of faculty and student populations within the institution changes concurrently with an expansion of external
stakeholder groups to include, inter alia, accreditation agencies. Levin (2004) also suggests, as long as a college continues to offer the full range of programs including certificate level and trades apprenticeships, the traditional focus on access will be maintained, although intra-institutional conflict over resource allocation may result from the expansion of mandate to include baccalaureate degrees. Skolnik (2011) notes that although the advent of college baccalaureate offerings appears to modify the relationship between the colleges and universities, this is less apparent when viewed from the perspective of the type and location of each institution’s students, and the type of degrees each offers. To the extent that degree offerings are unique to each type of institution, and different students are attracted to colleges and to universities, the binary structure may not significantly change.

Certainly, the introduction of baccalaureate programming appears to have contributed to changing structures and processes at Humber. Recruitment of full-time faculty increasingly prioritizes doctoral credentials, and students with the required high school credits for degree level study who apply to diploma programs are encouraged by admissions personnel to enter in a degree program instead, influencing the historical composition of the student population in diploma level courses. Over the last several years, the college has aligned course codes and credit values, required passing grade, and other academic policies and processes with those of other PSE institutions, including universities. One result is a reduction in flexibility and responsiveness in how students are able to be supported within academic schools.

Canadian federal immigration policy has had a significant impact on many aspects of Canadian life, including education. Since the late 1980s, population diversity in Canada has increased markedly due to high levels of immigration and changes in source countries. Historically Canada restricted immigration levels during recessions based on the rationale that the labour market was unable to absorb additional workers but this has not been the case in the past twenty years (Riddell, 2011).
Since 1990, with the exception of only two years, Canada has welcomed between 200,000-262,000 immigrants annually from more than 75 different countries. To put this in perspective, in 1985, immigration totalled 85,000 (Hiebert, 2009).

Since the late 1980s, fewer than 15% of new immigrants have had English or French as their mother tongue and a significant percentage did not speak either language. On average, since 1998, more than 21% of immigrants were children or youth less than 15 years of age, (Citizenship and Immigration Canada, 2001, 2004, 2011). Immigrants to Canada in the past 20 years have not experienced the earnings growth that earlier immigrants enjoyed and a higher percentage earns low incomes relative to Canadian-born individuals (Riddell, 2011).

Settlement patterns of immigrants arriving in Canada between 1996 and 2006 show a concentration of visible minority group members and immigrants in the major metropolitan areas of Montréal, Vancouver and Toronto. Compared to other Canadian cities, in 2006 Toronto’s population had the highest ratio of immigrants and visible minorities and a greater proportion of more recent immigrants. In 2006, 19.8% of Canada’s 31.6 million total population self-identified as immigrants, with 3.6% of the total arriving in the 2001-2006 period. For the three major cities the comparative figures are: 20.6% of the 3.6 million population of Montréal identified as immigrant with 4.6% arriving from 2001-2006; 39.6% of Vancouver’s 2.1 million population identified as immigrant with 7.2% arriving from 2001-2006; and 45.7% of Toronto’s 5.1 million population identified as immigrant with 8.8% arriving from 2001-2006 (Hiebert, 2009). During the same period the proportion of visible minorities in the Toronto population increased from 32% to 43%, compared to Montreal now at 16.5% proportion of visible minorities in the population and Vancouver, now at 41.7% proportion of visible minorities in the population. Toronto also registered the highest use of a language other than English or French at home – Montréal 12.1%, Vancouver 25.9%, Toronto 26.7% (Hiebert, 2009). In 2006, more than 26% of Toronto’s visible minority population lived in a minority group enclave, a geographic area where at
least 70% of the population is visible minority and the population of one group is dominant, compared with 0.8% in Montreal and 25.5% in Vancouver (Hiebert, 2009).

These demographics suggest a number of challenges for many students and for educational institutions in the Greater Toronto Area (GTA). In addition to immigrant students who have English language difficulties, some children born in Canada to immigrant parents speak no English when they are admitted into the public education system at age five. There are consistent reports that English language support for elementary and secondary students in Ontario is insufficient to meet the need (People for Education, 2007, 2011). Recent research has found that mathematics and science performance of 13 year old first generation immigrant children in Canada is substantially below average (Areepattamannil, 2010), possibly related to English language fluency. The impact of having to learn English as a second language (ESL) is not uniform among all ethnic groups. Research on educational trajectories for ESL students within the Toronto District School Board (TDSB) and elsewhere shows significant differences in secondary school outcomes for students of different ethnic backgrounds (McAndrew et al., 2009).

Language challenges do not disappear in the transition to PSE and the impact at that level is significant (Beletzan, 2008). Students who have not attained English language fluency when they enter PSE, particularly generation 1.5 students who immigrated to Canada between grades 3 to 7 or 8, struggle to be successful. Generation 1.5 students begin to learn English before they have developed academic literacy and higher level critical thinking skills in their first language and may graduate from secondary school without these skills in either language. These students enter college with an Ontario secondary school diploma and are often indistinguishable from native Ontario students in the classroom based on their facility with day-to-day language. As a result their academic difficulties related to literacy may not be recognized and they may not get the support they need to be successful. Many select their program of study based on their English language
proficiency rather than interest, for example choosing business or health sciences programs perceived to be less demanding of language skills. This may negatively impact their success since they are not pursuing the education they would otherwise choose (Beletzan, 2008).

Long term trends from 1970-2005 analyzed by Hulchanski (2010) show increasing polarization of income within the City of Toronto. Compared to 1970, in 2005 there were more well-off neighbourhoods and more disadvantaged neighbourhoods with a disappearing middle class. Low income neighbourhoods have migrated from the city centre to the inner suburbs, particularly the north-western and north-eastern quadrants of the city – areas remote from the major subway routes. The population in these neighbourhoods has also changed. In the poorer neighbourhoods, the percentage of individuals born outside of Canada has increased from 31% to 61% and there is a disproportionate number of visible minorities. By 2005, the population of the disadvantaged neighbourhoods had on average a lower level of academic achievement than the population of the wealthier or middle-class neighbourhoods and of Toronto as a whole (Hulchanski, 2010). United Way Toronto (2011) research shows that low income families in these neighbourhoods are increasingly housed in aging high rise rental buildings.

Poverty also has implications for student success at PSE. Research in the United States by Anyon (2005) highlights the impact of early learning deficits experienced by young students whose families are poor. These deficits do not disappear in the transition from secondary school to PSE and compound the challenges faced by those who also struggle with the language of instruction.

Historically, PSE opportunities were limited for young adults from such diverse backgrounds. Today, consistent with Trow's (1973) conceptualization of a universal PSE system, most young adults are expected to further their education after high school. PSE institutions continue to struggle with how to effectively support the increasingly diverse students who walk through their doors.
Rationale for the Study

Significance

The academic success of each student within an institution and program is related to the complex interaction of many factors (Finnie, Sweetman, & Usher, 2008; Tinto, 1993). To understand the dynamics of the relationship at the nexus of institution and student, detailed knowledge of that relationship over time is required (Andres & Adamuti-Trache, 2008), based on longitudinal "student level data" (The Educational Policy Institute [EPI], 2009, p.1) or "deep" data collection (Social Research and Demonstration Corporation, 2009, p. 34). Recent longitudinal research on PSE student pathways does not disaggregate the data at the institutional level, information which is necessary to identify which students are struggling (Kerr, 2010). In addition, few institutional studies have been sufficiently longitudinal to differentiate between students who drop out and those who stop out temporarily (Parkin & Baldwin, 2009).

Postsecondary institutions have immense stores of underutilized administrative data on individual students derived from their applications, their transcripts, and their use of services. Although student persistence is best measured at the system level so as to include inter-institutional transfers, persistence is usually seen as influenced and managed at the institutional level (Conrad & Morris, 2010). To effectively support student success, an in-depth understanding of both individual student academic pathways and academic achievement within the institution is necessary.

Need for the Study

This study examines PSE academic outcomes and academic pathways for students of one cohort in four general business diploma programs within one college, informed by a life course perspective. Humber is chosen as the site of the study because it is the college where I teach and advise students, and where, for six years, I had responsibility for three of the programs which are part of the
study. As a result, I have access to the historical institutional data and more important, personal knowledge and experience of the challenges faced by many of the students. Humber is the largest college in Canada, one of five colleges in the GTA, established in 1967 as a college of applied arts and technology (CAAT), as described above. Like the other GTA colleges, Humber is now designated as an Institute of Technology and Advanced Learning (ITAL), which means since 2003, it is permitted to offer up to 15% of its programming as applied bachelor degrees. In addition to degree level programming, it provides an array of full-time certificate, diploma, and post-graduate certificate programs. With two centrally located main campuses, Humber's function in the Ontario PSE system is to provide access to career-oriented applied learning and pathways to college and university degree-level study for a diverse range of students including nontraditional students from groups underrepresented in PSE. Implicit is the goal of expanding academic and occupational pathways for students thereby facilitating social mobility. Although program and institutional contexts will differ within and among the GTA colleges, these access programs and Humber's mandate can be seen to be generally representative.

Government priorities of increasing enrolment and retention are reflected in Humber's strategic plan and in its systems and structures. Strategic goals for 2008-2013 included annual enrolment growth, increases in student retention and improved graduation rates (Humber College Institute of Technology and Advanced Learning, 2011). To some extent, the goals of increasing access and increasing retention and graduation are in conflict. Widening access may mean admitting students who are less likely to be successful\(^1\). To the extent that Humber admits greater numbers of students

\[^1\] Not all Ontario secondary school graduates are academically prepared for PSE. Students can earn a diploma with achievement levels ‘much below’ provincial standards (see for example Ontario Ministry of Education, 2011). Almost 30% of Ontario 15 year olds who participated in the 2009 OECD Program for International Student Assessment (PISA) scored below the level of literacy necessary “to participate effectively and productively in life”, a rate that has remained stable over time (Knighton, Brochu, & Gluszniski, 2010, p. 25).
from groups less likely to navigate PSE effectively, there will be increased tension regarding student success.

Institutional discourse and narratives relating to student success reflect government policy and the historical theoretical frameworks foundational to research into postsecondary student retention and persistence. However, the definition of student success, how support initiatives are targeted and delivered, and the underlying assumptions relating to why students do not persist in PSE appear incongruent to actual student progression and experience within the institution. Since the drop-out rate is perceived to be highest at the beginning of a program, centralized student support initiatives at Humber are targeted to first term students. Students who leave later in a program are of a lower priority. Institutional strategies to retain students are bi-modal, consisting of (1) student self-identification of skill and learning deficits through a first term volunteer survey with self-advocacy for support services, and (2) targeted support to groups of students perceived by demographic characteristic to be at risk of dropping out, for example, first generation students, whose parents did not pursue PSE. Strategy 1 presumes sufficient agency and ignores structural, systemic and personal barriers; strategy 2 does not acknowledge the significant diversity within student groups identified by demographic characteristic (Anisef, Brown, Phythian, Sweet, & Walters, 2008; Canadian Council on Learning [CCL], 2008a; Kim, Sax, Lee, & Hagedorn, 2010; Lang, 2009).

Individual student persistence can be tracked by individual academic record but it is not a nuanced device. Some students follow the traditional path of full-time fall-winter enrolment and graduate when expected. Some students leave early in the first term; others leave later in their program. Some are required to withdraw for academic reasons. Students who leave, those who persist, and those who leave and return experience varied levels of academic success. Students who leave and do not return, we know little about. Retention policy does not differentiate among students regarding their academic achievement while at Humber. All who do not return are considered dropouts. It is
unknown how common these pathways are or whether there are identifiable academic barriers for those students who do not persist.

Institutional language ties student success to student group level characteristics considered to place the student at risk of dropping out, for example being a mature student or a first generation student, and student persistence to *student engagement*, a more recent focus of PSE institutional quality and effectiveness. Implicitly, a lack of persistence is a failure of the professor to engage each student in the classroom. From the faculty perspective, academic success or the lack of same often appears related to student behaviour. Students display varying levels of personal responsibility and commitment to their studies. Many juggle multiple roles with family and job responsibilities; some have unrealistic expectations of the time and effort required to succeed academically. Some students face challenges related to overall cognitive ability, the presence of a disability, under-preparedness in mathematics and/or English, or difficulties with setting/meeting goals or time management. Students’ short term decisions are often inconsistent with what is assumed to be their long term goal – graduation with a Humber credential.

Ontario college students are evaluated against expected learning outcomes for each course, (i.e., not relative to the performance of other students). As part of its strategy to reduce the number of students dropping out of high school and increase Ontario secondary school graduation rates over the past decade, the government implemented policies at the secondary level which are different from accepted academic policies at the postsecondary level. Some students arrive at Humber accustomed to credit recovery initiatives including modified learning outcomes, no-fail policies, flexible/no deadlines, and having the opportunity to make-up failing final grades at the end of the year, none of which are options at the PSE level.

In addition to having diverse PSE goals and facing challenges related to academic and personal skills, students who persist often face structural and systems barriers related to the assumed student
pathway. For example, the program curriculum, based on provincial standards, is laddered. Earlier courses are prerequisites for later courses. All business diploma students admitted to Humber complete mathematics and English placement tests before beginning first year. Test results determine whether the student is placed in the required mathematics and English classes for the first term of their program or in remedial courses which are not part of the program curriculum. Being placed in a remedial course or needing to repeat a course has an impact on progression.

To be eligible for financial aid, students must maintain a minimum course load – one which may be too heavy given their academic readiness and the complexity of their lives. Part-time students and those repeating a course do not have priority access to daytime classes. Evening courses may be inaccessible because of a long commute and online course options are not a good fit for students who learn best in a classroom. When a student is placed in a remedial or pre-curriculum mathematics or English class, must repeat one or more courses, or self-selects courses out of sequence, program completion is likely to be delayed and the student must bear additional tuition and opportunity costs. These students find themselves misaligned with their peers and on pathways which diverge from institutionally defined and structured progression and scheduling, affecting their success. Settersten (2007) notes,

when individuals choose or find themselves on pathways that are not widely shared by others or reinforced in institutions or policies, they may lose important sources of informal and formal support and find that their pathways and well-being are more prone to breakdown. This is where new questions about risk come into play, as atypical pathways, whether actively chosen or the result of personal or external circumstances, leave individuals vulnerable as they move through social institutions or are subject to social policies based on models of life that no longer reflect the realities of the contemporary world or the actual experiences of people. (p. 244)
Policy and institutional discourse, structures, expectations and measurement of PSE outcomes, and the foundational theoretical frameworks regarding PSE student success reflect historical models of student success and the traditional PSE student - direct entry from high school, full-time, resident on campus. They are incongruent with the academic experience of many students today.

Few college students can be considered traditional. Even students perceived as traditional by some measures may see themselves as nontraditional in other respects (Kim et al., 2010) and subtle differences in student characteristics appear to have significant impact on the student experience for some students (Lehmann, 2007). Today’s college students are diverse – along more parameters than historically considered. Job dislocation has driven adult students back to college to upgrade their skills alongside direct entry secondary school graduates and mature students who may not have a secondary school diploma. Students may be recent, longer-term, 1st, 2nd, or 3rd- or-more generation immigrants from a wide range of countries with diverse family backgrounds, diverse family compositions, diverse religions, cultures, and value systems, and diverse orientations to education and to time. Students have experienced diverse neighbourhoods and schools (Anisef, Brown, Sweet, & Walters, 2010; Hiebert, 2009; Hulchanski, 2010) and bring with them varied levels of academic, financial and personal skill resources (Association of Canadian Community Colleges [ACCC], 2007) to support postsecondary studies. In an increasing number of programs students have options for study modes: full-time, part-time, daytime, evening, on-line and year around enrolment. Students are frequently juggling multiple roles and responsibilities.

Research into student success in PSE is extensive. Prior to 1969, there were more than 1,000 empirical studies relating to how the PSE experience affected students (Astin, 1970a). Since then there have been thousands more. In particular, PSE student success, as measured by retention and completion has been a research focus for more than 40 years. Theoretical models of the PSE student experience have been broadly categorized as developmental, focussed on individual student
psychosocial development during PSE, or sociological, focussed on the PSE environment and its effects on students (Pascarella & Terenzini, 2005). The most influential development model is Chickering’s (Chickering & Reisser, 1993) seven vectors of development. Another significant model, described as “occupy[ing] the middle ground between psychological and sociological explanations of student change” (Pascarella & Terenzini, 2005, p. 53) is Astin’s (1970a, 1970b, 1993, 1999) input-environment-outcomes (I-E-O) model and theory of involvement.

Since the 1970s-1980s, when PSE systems had transitioned from elite to mass (Trow, 1973) albeit with a more homogenous student population than today, the sociological college-impact models have dominated policy regarding retention and completion. Two theoretical frameworks in this field with some empirical support – Tinto’s (1975) student integration model, and Bean (1980), Bean and Metzner (1985), and Metzner and Bean’s (1987) student attrition model – were foundational to student success research (Dietsche, 1990) within the Ontario college system in the late 1980s. Dietsche’s (1990, 1995) research, in turn, significantly influenced both the development of the KPIs used by the MTCU since 1997-98 to measure PSE institutional outcomes (ACCC, 2005) and how Ontario colleges perceive and measure student success.

The most recent focus of PSE institutional effectiveness regarding student success is the concept of student engagement, which has features in common with these earlier models, although not specifically addressed by them. Many definitions of student engagement exist, encompassing aspects of student behaviour including motivation, attention, effort, and commitment. Dunleavy and Milton (2010) in Education Canada identify three dimensions of student engagement from a school-based perspective, social, academic and intellectual, relating to students’ participation in each of these realms. In higher education in both Canada and the United States, the dominant articulation of student engagement is that of the U.S. National Survey on Student Engagement (NSSE), a student survey which has been widely used by PSE institutions in both countries as a quality measure.
NSSE defines student engagement as “the amount of time and effort students put into their studies and other educationally purposeful activities” and “how the institution deploys its resources and organizes the curriculum and other learning opportunities to get students to participate in activities...linked to student learning” (NSSE, 2014). Student engagement is considered by NSSE to be a key indicator of learning and, therefore, of the quality of an institution. NSSE, developed in 1998, is based in part on research on Tinto’s (1975, 1993) and Astin’s (1970a, 1970b, 1993, 1999) models; however, there is little empirical research relating student engagement to retention and graduation (Gordon, Ludlum, & Hoey, 2008). Within Humber, student engagement tends to be narrowly interpreted as relating to the number of students who participate in activities such as orientation and what the faculty do in the classroom to engage students, a perspective which minimizes institutional and student contributions to the learning process.

Empirical research that directly informs knowledge of intra-institutional student academic pathways and contextually specific supports and barriers to success is lacking. Canadian empirical research on PSE retention and persistence can be broadly characterized by three parameters: geographic/hierarchal location (national, provincial or institutional level); type of institution (college/university); and time period. Longer term longitudinal research which relies on national or provincial system level data and provides information on various aspects of student persistence in PSE is not representative of college students at a single institution (for example, Andres & Wyn, 2010; Doray et al., 2009; Finnie, Childs, & Qui, 2010; Finnie, Childs, & Wismer, 2010; Finnie & Qui, 2008a; Lambert, Zeman, Allen, & Bussière, 2004; Looker & Thiessen, 2008; Ma & Frempong, 2008; Thiessen, 2007). The many institutional research studies related to retention and persistence provide limited information because student success is seen as context dependent at the student-institutional level (Grayson & Grayson, 2003; Usher & Potter, 2006). Other limitations to institutional research include the short time frames of the studies (for example, Dietsche, 1990), the limited measures of academic achievement tracked (for example, Fisher & Engemann, 2009), and the
narrow focus on specific student groups (for example, Grayson, 1997; Grayson, 1998; MacFadgen, 2008; Palameta, Voyer, & Social Research and Demonstration Corporation, 2010; Sweet, Anisef, Brown, Walters, & Phythian, 2010) or specific aspects of student performance (Le & Milburn, 2010; York-Seneca Institute for Mathematics, Science and Technology Education, 2010). Much of the institutional research has focussed on traditional full-time students.

Other institutionally specific research relates to short-term interventions or pilot studies designed to increase retention of students perceived to be at risk of failure, generally identified by entry characteristics (for example, Angrist, Lang, & Oreopoulos, 2009; Colleges Ontario, 2011b). There is limited research examining the interaction of institutional structures or practices and persistence (for example, Lindo, Sanders, & Oreopoulos, 2010). There is no institutional research tracking individual student academic pathways beyond the expected completion deadline. More important, other than research utilizing data from several long term longitudinal studies, for example, the 22 year Paths on Life’s Way project in British Columbia (Andres & Adamuti-Trache, 2008; Andres & Wyn, 2010) and the 10 year Youth in Transition Survey (YITS) (Finnie, Mueller, Sweetman, & Usher, 2008), the broader social and economic context external to the PSE institution including secondary school academic choices and outcomes is rarely integrated with the student level analysis.

The current study contributes to the literature in the following areas: it provides detailed information on individual student academic and achievement patterns within one institution for nineteen academic terms from fall 2006 to fall 2012, beyond the expected time frame for graduation; it tracks a range of academic achievement measures other than graduation rate, including total courses enrolled, total courses passed, course completion rate, and graduation beyond the policy mandated graduation deadline; it explores relationships between academic achievement measures and academic pathways, and student demographic characteristics, prior academic characteristics, and student behavioural and academic characteristics related to the student – institution interaction at the
time of entry. Uniquely, this research is informed by a life course perspective where student achievement and pathways are nested within family, work and community spheres and influenced by these both implicitly and explicitly on an ongoing basis. This perspective situates PSE as an integral part of life's other trajectories rather than a stand-alone transition to be traversed between secondary school and the work force, divorced from family, work and community external to the PSE experience.

Conceptual Framework – Transition within the Life Course

Life course research attempts to understand the mechanisms at the individual, institutional, and policy levels which affect the social structuring of individual lives – the influence of earlier life factors on later life trajectories and how the influence occurs (Mayer, 2009). The life course perspective “denotes an interrelationship between individuals and society that evolves as a time-dependent, dynamic linkage between social structure, institutions, and individual action” (Heinz, Huinink, Swader, & Weymann, 2009, p. 15). As articulated by Elder (1998), the life course is conceptualized around four core principles: "historical time and place" – an individual’s life course occurs within and is influenced by the time and place of lifetime experiences; "timing in lives" – the effect of a life transition on individual development is related to the time of life it occurs; "linked lives" – lives are interdependent and reflect historical and social events impacting the web of relationships; and "human agency" – life courses reflect individual choice based on the options and restrictions offered by "historical and social circumstances" (Elder, 1998, p. 2-3).

Historical forces shape the social trajectories of family, education, and work, and they in turn influence behavior and particular lines of development. Some individuals are able to select the paths they follow, a phenomenon known as human agency, but these choices are not made in a social vacuum. All life choices are contingent on the opportunities and constraints of social structure and culture. (Elder, 1998, p.1-2)
The timing, duration, and outcomes of a particular transition may reflect the effects of structures, institutions, and individual behaviour from previous transitions and life stages. The transition through PSE has been characterized as one of five normalized social trajectories or pathways young adults traditionally navigate in becoming an adult, together with living independently of parents, taking on full-time year around employment, entering into a permanent conjugal relationship and having children (Clark, 2007). Students' transitions into PSE reflect their experiences, the historical and social contexts of their lives, and the exercise of individual agency based on the opportunities and constraints presented (Côté & Bynner, 2008; Elder, 1994, 1998). Within PSE, students build on their own personal educational experiences from elementary, secondary and prior postsecondary studies, and have their own motivations and goals for being there (Colleges Ontario, 2013; Côté & Levine, 1997; Martell, 2011).

In addition to being affected by previous trajectories and transitions, individuals are perceived as having agency and acting on trajectories:

The life-course framework points at the agency of 'life-course travelers'. Youth and young adults are not mere carriers of family values, school experiences, and diplomas; they have to organize their status passages as well by using educational resources and acquiring additional qualifications as required. (Heinz, 1999, pp.5-6)

Student PSE trajectories or pathways reflect the institutional context of PSE, broadly construed at the system and policy level as well as at the organizational level of the particular institution. Student choices in education at important transition points are affected by social class and institutional structures (Andres & Adamuti-Trache, 2008). Andres and Grayson (2003) describe the advantage some youth enjoy as “parental privilege…passed on to…children via the route of educational attainment” (p. 194), however, within life course research, educational attainment is identified as a "crucial intervening outcome" (Mayer, 2009, p. 417), which may alter life trajectories created by early
childhood conditions. Laub and Sampson's (2003) longitudinal research on the life trajectories of young criminal offenders to age 70 demonstrates that institutional influence and individual agency can transform earlier trajectories; that childhood and young adult circumstances do not determine later outcomes and pathways.

**Research Objectives**

The purpose of this research is to explore and map the multi-dimensional diversity of PSE students and their academic pathways at one college in Ontario. As demonstrated by the research of Andres and Finlay (2004), to support students effectively with limited resources, we need to understand the student-institution dynamic at the level of the individual student within the context of the particular institution. An analysis of individual student academic enrolment and achievement patterns longitudinally, matched with individual student demographic, prior academic and college entry characteristics enhances understanding of individual PSE pathways, academic achievement, and institutional barriers to success generally and in particular for students who are seen to be part of underrepresented groups in PSE today. The following are the research questions this study is designed to answer:

**Question 1:** In what ways, if any, do student academic achievement, represented by course and credential completion, and student persistence, represented by course enrolment, at Humber College differ from the policy-mandated, reported graduation rate?

**Question 2:** In what ways, if any, do the demographic, prior academic, or college entry characteristics of students at Humber College appear related to student academic achievement and persistence?

**Question 3:** In what ways, if any, do the academic pathways, represented by longitudinal patterns of enrolment and achievement, of students who persist in their studies in programs at Humber College differ from those who do not persist?
Question 4: In what ways, if any, do the demographic, prior academic, or college entry characteristics of students at Humber College appear related to student academic pathways?

Assumptions and Limitations

The major limitations of this study are the authenticity of the student demographic data and the generalizability of the research findings. Student demographic data were self-reported at the time of application to the college through the Ontario Colleges Application Centre and are assumed to be accurate. The results of the study reflect the demographic data and academic performance results of students in one cohort of four general business programs within one community college in the GTA. They may not generalizable to other student cohorts in the same programs within the institution at a different point in time or to other student cohorts in other programs within the same institution or at any other college or university. However, the use of institutional data to understand the dynamics of individual student-institution relationships may be generalizable to other student groups and other PSE institutions. Although the findings are not generalizable to other student groups, based on the principle of transferability, the research design, methodology and findings may be suggestive of connections for other researchers. The research is significant in that it provides in-depth insights into patterns of persistence which may provide the basis for additional research in the future.

Operational Definitions

Academic Pathway

In this study I use the term academic pathway to describe the academic milestones and parameters of student PSE experience including – by term – enrolment status at the beginning of the term, level of achievement as a function of courses passed compared to enrolment status, and graduation. The PSE journey of many students is not congruent with traditional PSE models of enrolment. Using the
term *pathway* to represent this journey is consistent with existing longitudinal research which shows that the PSE student experience is often not linear or unbroken (Andres & Wyn, 2010; Doray et al., 2009; Lavin, 2011).

**Student Success, Persistence, and Retention**

The concept of PSE student success has multiple dimensions. Expected outcomes from student participation in PSE include development of communication, numeracy, subject matter and cognitive skills and personal growth relating to attitudes, values and morals (Pascarella & Terenzini, 2005). The OECD and government policy emphasize the measurable dimensions of student success, primarily the completion of a diploma or degree (graduation), particularly in a PSE environment of restricted funding and inter-institutional/international competition for students (for example, OECD, 2012).

To complete a credential a student must continue or persist in his or her studies until that point. Although often used interchangeably with *retention*, *persistence* has traditionally been defined from the student perspective, as student adherence to a pattern of full-time PSE enrolment during the fall and winter terms, repeatedly and consistently until graduation. Retention, generally calculated as the number of full-time students who re-enrol year-over-year, is this pattern from the perspective of the PSE institution. Non-continuation of enrolment is the opposite of persistence/retention. Institutions regard a student not re-enrolling when expected as dropping out, as failure, and the measurement system counts it as permanent.

Retention and graduation rates are considered measures of quality. One weakness is that, all things being equal, students who are the least academically prepared are the most likely to leave. An institution could therefore increase its retention and graduation rates by raising admission standards although this runs counter to policy priorities of increasing access to PSE. Astin (1997) developed a
conceptual model for an expected retention rate reflecting student characteristics such as sex, race, high school grades, and admissions test scores. Actual retention and graduation rates could be compared against those expected, more accurately reflecting institutional effectiveness regarding student development. Sax (2005) more recently advocated a similar approach based on retention-related student survey variables from the Cooperative Institutional Research Program of the Higher Education Research Institute in the United States. Although an improvement over current measures, an expected institutional rate may inadequately represent individual program rates. Institutions would still have an incentive to lower academic standards in order to retain and graduate students. Given the heterogeneity of students today, arguably it is not possible to calculate reliable program or institutional expected graduation rates.

The traditional definition of retention also has limited relevance today given the reality of student PSE experience. Hagedorn (2006) highlights the challenges of defining enrolment as either/or. The dichotomous policy perspective of either full-time retention/persistence or dropping out does not reflect student transfers between full-time and part-time status within one institution or transfers between institutions. Nor does it reflect the withdrawal of a student by the institution for academic reasons, or the voluntary and temporary departure of a student during or after a term who returns in a subsequent term. A student who transfers to another institution is counted as dropping out of the first although s/he is persisting in PSE at the second. Adelman (2000) argues community college students, many of whom have goals other than credential completion, should not even be counted as enrolled until they have earned a minimum number of credits, based on data from the High School and Beyond Sophomore Cohort national longitudinal study in the U.S. which show one in six can be seen as incidental students. According to Adelman, including these students in institutional measures of accountability is unfair and inaccurate.
In Ontario, reflecting OECD priorities, PSE policy goals for students are fixed and relate to maximizing retention and credential completion within a defined period of time. Government funding is based on full-time enrolment and re-enrolment. Retention is reflected in institutional measures of quality and accountability - KPIs – many of which relate to graduation. Dietsche (1995), former Director of Institutional Research at Humber who participated in the development of the college system KPIs has been explicit: “Given that one of the community college’s principal functions is the development of its students, increased retention and graduation rates signify improved quality” (p. 430).

While one could argue that retention and graduation are merely proxies for the multi-dimensional student growth and development expected from PSE participation and are inadequate measures of quality, it is a discussion well beyond the scope of this research which is focussed on how these concepts are defined from a policy perspective and the affect on students.

It is recognized that student goals often do not match institutional goals. In action research with small groups of first-year students from three distinct PSE institutions in British Columbia, Andres, Andruske, and Hawkey (1996) found that many administrators and faculty acknowledge that some students will leave a program before completion because it does not meet the students’ needs. This contributes to tension between institutional goals to support students and the need to meet government policy expectations on retention and completion. Recent Ontario research confirms the diverse perceptions of what constitutes student success among students, staff, faculty and administrators within PSE institutions (Seifert & Peregrina-Kretz, 2013).

Côté and Levine’s (1997) longitudinal research into the fit between student motivation and educational environment at a large Ontario university also found that student motivations for attending university were more diverse and complex than graduation and receiving a credential. Using a research-based student typology of five motivations – career-materialist, personal-
intellectual development, humanitarian, expectation-driven and default – Côté and Levine (1997) surveyed a sample of first-year students who had similar social class backgrounds with a follow-up survey two years later. They found that thirty-three percent of the students could be characterized as having one motivation. These students, Côté and Levine argued, were likely unrepresentative of student populations in general since most of the students had more than one. Motivation was associated with self-reported skills acquisition and also appeared to be stable throughout the research period and therefore not affected by the PSE environment. These motivations could be described as what the students believe they will achieve from PSE participation. From this perspective a credential represents an achievement rather than the achievement. Depending on the motivation, credential completion may not be necessary for a student’s goals to be achieved. Based on the same sample and study (1997), Côté and Levine (2000) also analyzed the relationship between measures of intelligence and motivation, university institutional environment and outcome skill acquisition. They were surprised to find a negative relationship between intelligence and outcome skills acquisition. Motivation was the best predictor of skills acquisition. Although these results are limited to the sample of students of similar background at one university, more recent research confirms that student goals at the time of enrolment in PSE are diverse.

Based on data from the British Columbia 2009 Short Stay/Early Leaver Student Outcomes Survey, Martell (2011) found that almost half of the respondents who had left the B.C. public PSE system prior to graduation identified goals other than credential completion at the time of enrolment.

Results from the 2012 Applicant Survey by Academica Group Inc. (Colleges Ontario, 2013) show college applicants identified various and multiple reasons for applying including career preparation (83%), future options (66%), personal and intellectual growth (66%), knowledge (66%), meet new people (48%), leadership skills (34%), giving back to society (30%), social status (23%), could not find a job (9%) and not sure of what to do (4%). In results from the Ontario MTCU 2012-13 Student
Satisfaction Survey, the primary goal identified by the majority of college students regardless of credential is to prepare for continued education or to enter the job market (Colleges Ontario, 2013).

Although students who enrol in massive open online courses (MOOCs) do not represent the traditional undergraduate student (Anderson, 2013), research into these students' motivations, behavior and completion rates is informative. In general, only a fraction of students who enrol in a MOOC complete it. One study (Jordan, 2014) calculated the average enrolment for a single MOOC as almost 43,000 students with completion rates of less than 6%. Diverse student motivations are imputed from such large enrolment levels (Wang, 2014) and preliminary research (Connors, 2013; Wang & Baker, 2014) supports this presumption; identified student goals include personal interest in the topic, professional development, and that the course was free (Connors, 2013). Koller, Ng, Do, and Chen (2013) distinguish motivation from learner intent, which they suggest can be gleaned from student interaction behaviour in the MOOC. Four common MOOC student profiles have been identified based on online interaction patterns: lurkers, passive participants, active participants, and drop-ins, seen as suggestive of diverse student goals (Hill, 2013). One case study notes higher completion rates for students who invested more in the MOOC as demonstrated by their participation in and completion of available projects and assessments (Balch, 2013). Course completion and retention research with data from nine HarvardX MOOCs (Reich, 2014) found that student self-identified intention at the beginning of the MOOC, while somewhat flexible and not determinant, appeared related to completion and retention rates. Reasons postulated for MOOC low completion rates as compared to university course completion rates include ease and low cost of both signing up for and dropping the course (Balch, 2013), suggesting that retention and completion rates are related to student personal resource demands and the perceived added value of the credential.

This multi-faceted body of research suggests that student persistence in PSE is complex and multidimensional and relates to both personal and structural characteristics with differences related
to institutional and program context within the PSE hierarchy in Ontario. Compared to university programs, many college programs including those which form the basis of this study are lower cost and higher ease of entry through lower admissions standards and flexible start dates and modes of study, perceived lower consequence for non-completion and lower market currency for completion, all parameters which may influence student persistence and success.

In practice, students’ goals often appear to be fluid and flexible particularly regarding time frame. In my experience advising students, when students discuss discontinuing their studies, they generally see it as a temporary decision relating to more urgent priorities and responsibilities such as getting a job, supporting family members, travelling, or managing health concerns. For some students, leaving PSE prior to completion of the program they are enrolled in demonstrates critical thinking, problem solving and flexibility, all skills considered necessary for success in the 21st century. This is not to say that for others, dropping out does not represent failure. Some who leave before completion would prefer to stay but lack the skills, resources, supports or motivation necessary to progress. However, some who leave do return with increased focus. The time removed from the education system may result in more clearly articulated personal goals. Remaining in a post-secondary program when it is not a good fit with a student’s needs and goals is a waste of financial resources, particularly in an environment of increasing tuition. A policy focus implicitly emphasizing retention of all students once they have enrolled ignores the perspective of individual students and disavows student agency.

Terminology used in longitudinal research regarding student paths through PSE reflects the research focus of the particular study as well as, often, normative expectations regarding enrolment status. For example, Dietsche (1990) used successful persisters, successful leavers, unsuccessful persisters and unsuccessful leavers to describe student paths within one institution over one year, with success defined according to institutional and policy-related goals. Martell (2011) used short
stay and early leaver differentiating students by the number of courses they had taken prior to leaving PSE, suggesting norms related to duration of enrolment, and happy leavers and unhappy leavers differentiating students by how satisfied they said they were in survey responses about their PSE experience. Lavin (2011) categorized students based on their enrolment, completion and transfer paths over a seven-year period.

My research focus is on student persistence and academic pathways at Humber and the terminology I use reflects a broad and purposefully neutral perspective on different enrolment statuses. In contrast to Parkin and Baldwin's (2009) definition of persistence as “the ability of a student to continue postsecondary study from one year to the next and ultimately proceed to the completion of a program” (p.1) focussed on ability and completion, I define persistence as the continuation of enrolment on a full/part-time basis with no limitation on the number or duration of breaks during the research period. Persistence may, but does not have to, end with completion of a credential. I use the term retention as it is defined by Ontario PSE policy described above. Those who cease enrolment voluntarily and do not return are described as not enrolled at the institution. Students who are required to leave a program for academic reasons are described as withdrawn. Students who continue to enrol in evening and/or online courses through Continuing Education while withdrawn are described as enrolled while withdrawn.

Graduation Rate and Other Academic Achievement Measures

From an institutional perspective graduation is a measure that reflects government policy of counting and reporting the number of full-time students who complete a PSE program within a defined period of time from initial enrolment. The Ontario KPI graduation rate is measured institutionally on a cohort basis as the percentage of full-time students who complete a program of a minimum of two terms or semesters within 200% of the regular program length. For example, for a three-year advanced
diploma, the graduation rate is the percentage of full-time students who begin the program full-time in September and complete the program by the end of August six years later.

Students who have transferred out of the initial program of enrolment into another program in the same institution are removed from the initial entry cohort and counted as successfully only if they graduate in time from the second program. Students who transfer to part-time status are considered to have dropped out because they are no longer enrolled full-time. International students are not included in the government graduation measure. Institution and program graduation rates are reported on the Ministry website and are used by stakeholders to compare institutions, just as national graduation rates are used globally, as indicators of institutional and system quality. Adelman (2000) argues that credential completion should be a systems-level, student-focussed measurement over a period of more than five to six years. The KPI measure falls short of Adelman’s (2000) ideal in two ways. It is not a systems-level measure, therefore graduation rates are underreported, and the time-period parameters are too limited and too short.

It is a truism that what is counted matters and what is not counted does not. As one of the most widely used systemic and institutional measures in PSE, the problem with graduation rates as commonly defined lies with who and what is left out. Students who graduate outside of the 200% parameter are not counted as successful from a policy perspective. Students who complete courses but not a credential are counted as failures and the academic credits they have attained are disregarded. Students who successfully complete postsecondary programs of less than one year or complete a program while enrolled part-time are ignored. These academic achievements are not valued in our current PSE system notwithstanding the fact that all education has value along multiple dimensions.

For the purposes of this study, I measure PSE success in five ways. I define graduation rate as per government policy described above and graduate with a diploma or higher credential to account for
all students who completed at least a two-year credential within the research period. In addition, I use total courses enrolled to account for all course enrolments by each student, total courses completed to account for all program related courses successfully completed by each student, and course completion rate, to measure individual student course completion as a percentage of courses enrolled to account for the alignment of student academic achievement with student intention at the time of enrolment with or without program completion during the research period. The term academic achievement encompasses both total courses completed and graduate with a diploma or higher credential. These measures will more accurately account for academic achievement by the cohort regardless of enrolment status.

Summary

Humber lacks detailed knowledge about individual student academic achievement and the characteristics and academic pathways of students who persist in their education and those who do not. Discourse about, support for, and measurement of academic success are framed by theoretical frameworks, systemic policy assumptions and structures which do not reflect the reality of student experience. Mapping the complex and diverse student academic experience within the broader social, economic and policy context and the individual context and prior academic trajectories of individual students provides greater understanding of the student-institutional interaction relating to persistence in postsecondary studies, informing institutional and possibly provincial educational policy.
Chapter Two: Review of the Literature

Research regarding students in PSE is not new. More than 1,000 empirical studies regarding how the PSE experience affected students were undertaken prior to 1969 (Astin, 1970a). Since then there have been thousands more. For example, a search in Google Scholar of the terms student development in postsecondary education during the period 1970 - 2014 produces approximately 35,500 results (Google Scholar, 2014). In particular, PSE student success, as measured by institutional retention of primarily full-time students and by program completion, has been a research focus for more than forty years. There is also significant research and knowledge about the characteristics of students who access PSE (including by college or university path) and those who do not. Much less is known about student persistence within PSE.

The review of literature begins with a brief outline of the dominant theoretical models of the PSE experience and critically examines the frameworks that have had significant and lasting impact on the discourse, policies and measurement of student success in the Ontario community college system. An alternative perspective of PSE as a major life course transition is then reviewed. This is followed by a review of the Canadian empirical research on postsecondary student persistence highlighting the need for an institutionally focussed longitudinal examination of individual student academic pathways.

Theoretical and Conceptual Frameworks

Dominant Theoretical Frameworks and Limitations

Theoretical models of the PSE student experience have been broadly categorized as developmental, focussed on individual student psychosocial development during PSE or sociological, focussed on the PSE environment and its effects on students (Pascarella & Terenzini, 2005). The most influential developmental model is Chickering’s (Chickering & Reisser, 1993) seven vectors of development
where student identity development evolves through the dynamics of developing competence, managing emotions, moving through autonomy toward interdependence, developing mature interpersonal relationships, establishing identity, developing purpose and developing integrity. Student growth and development is considered to occur as the student moves simultaneously along each vector, not necessarily at a uniform speed. Movement along one can interact with movement along another and can include retracing ground already covered.

Astin’s (1970a, 1970b, 1993, 1999) input-environment-outcomes (I-E-O) model and theory of involvement has also been influential in PSE research. Described as “occupy[ing] the middle ground between psychological and sociological explanations of student change” (Pascarella & Terenzini, 2005, p. 53), the I-E-O model and theory of involvement describes the effects of college through "inputs" (personal and academic characteristics students bring to PSE), "environment" (aspects of the PSE institution), and "outcomes" (students characteristics after their PSE experience). Student outcomes are not limited to academic achievements such as persistence or graduation. They also encompass beliefs, values, attitudes, and political orientation. How students change as a result of their PSE experience relates to student involvement, “the amount of physical and psychological energy that the student devotes to the academic experience” (Astin, 1999, p. 518), a construct which Astin sees as the “behavioural manifestation” of motivation (p. 522). Astin’s (1993) research has focused primarily on full-time four-year degree students in the United States.

For decades, the sociological college-impact models have dominated PSE policy regarding retention and completion. Two theoretical frameworks in this field which have some empirical support – Tinto’s (1975) student integration model and Bean’s (1980) and Bean and Metzner’s (1985) and Metzner and Bean’s (1987) student attrition model – were foundational to Dietsche’s (1990) research into student success at Humber in the late 1980s and are the focus of this section of the literature review. Tinto’s (1975) theoretical model (see Figure 2), based on the fit between the
student and the institution, conceptualized dropping out as “a longitudinal process of interactions between the individual and the academic and social systems” (p. 94) of the postsecondary institution. Dropout, the dependent variable, is a one-time, final event.

**Figure 2: Tinto’s Theoretical Model of Student Departure**

Independent variables include student background characteristics, and commitment to the institution and to the goal of education. Although not conceived as linear, Tinto suggested longitudinal data in a path model would be an appropriate evaluation technique. Path analysis is a method of statistical analysis that tests hypotheses of direct and indirect linear cause and effect relationships between variables as *assumptions* of the model rather than outcomes. These assumptions are tested to see if the assumed relationships are consistent with the data, but consistency does not prove causation (Webley & Lea, 1997). Tinto’s (1975) model identifies goal and institutional commitment as student entry characteristics which may be subsequently influenced by a student’s academic and social experiences within the institution. The more a student is integrated socially and academically into
the institution as a result of his or her interactions and involvement with faculty and peers, the greater the student’s goal and institutional commitment and the greater his or her persistence. Based on survey and institutional data of traditional, full-time, resident-on-campus students, Tinto (1975) found that both academic and social integration were associated with persistence, consistent with the model.

Although Tinto’s (1975) model has some empirical support (Braxton & Lien, 2000; Pascarella & Chapman, 1983; Pascarella, Terenzini, & Wolfe, 1986), it is also seen as limited to traditional, full-time, resident-on-campus students particularly given the diversity of today’s PSE students (Andres & Carpenter, 1997; Andres & Finlay, 2004, Introduction). It is also limited by the assumption that factors external to the institution only indirectly affect drop-out decisions. This implies the institution can affect goal and institutional commitment by increasing student integration regardless of the student’s external environment. The reality is that many students have significant social, family, and work connections off campus. It is difficult to conceive that these would not have an impact on some students’ academic/social integration in ways the institution would not be able to counteract, particularly given the technological ease of remaining externally connected while on campus through smart phones and social media. At the time this model was theorized, this assumption may have been supportable, particularly considering that the model relates to full-time students who live on campus. It is likely less relevant to students today.

Bean (1980) extended Tinto’s (1975) conceptual model to include intent to leave based on organizational theories of employee turnover. Bean and Metzner (1985) and Metzner and Bean (1987) further extended the model to nontraditional students, which they defined as students age 25 or older, part-time, non-resident on campus, for whom social integration, interaction with on campus peers and faculty, is assumed to not be as relevant. Also included in the revised model were external environmental variables postulated to pull students away from integration in the institution (Figure 3).
Consistent with Tinto’s (1975) model, dropout was conceptualized as a longitudinal process—a path model with four sets of variables: academic performance, intent to leave, background and defining variables including educational goals, and environmental variables. Metzner and Bean (1987) empirically tested this model based on an in-class survey of 624 part-time, commuter first-year students. In contrast to Tinto’s (1975) research, they found that dropping out was related to
academic factors, not social. The model explained 29% of the variance in dropout in the groups of students surveyed. External environmental variables appeared to affect dropping out indirectly through intent to leave.

Although Metzner and Bean (1987) defined nontraditional students narrowly based on certain student demographic characteristics, they considered that a nontraditional student was one for whom social integration was not relevant because of the student’s orientation towards responsibilities off campus. This conceptualization may be relevant regarding commuter and other students who have extensive and ever-present external ties to work, family, and community relationships, similar to Humber students today. Metzner and Bean (1987) suggested the difference between traditional, residential students and non-traditional students relates to extent of social interaction. Consistent with this, differences between student groups might also be related to extent of academic interaction. Commuter students enrolled part-time might have less academic integration than those enrolled full-time due to decreased time in-class and on campus. Students enrolled in online courses might have even less. Both social and academic integration on campus might also be affected by how individual students use technology to remain engaged with external relationships while simultaneously multi-tasking with academic activities.

Of the many research studies on PSE retention and persistence, one of the most relevant to the context of my research is a study conducted at Humber by Dietsche (1990) on student retention based on Tinto’s (1975) model of student-institution fit extended by Bean’s (1980) intent to leave. Dietsche’s (1990) attrition research was based on survey information from the fall 1985 incoming cohort of full-time students. The purpose of the study was to evaluate empirically the person-environment fit of dropout for freshman student groups within a vocationally focused, community college. The justification for the research (the problem) was the “wastage of human and financial resources” (p. 66) that occurs when students drop out of higher education without completing a
credential. To "minimize" this, more information on the "dropout process" (p. 66-67) was needed in order to identify policies and practices to support student persistence.

Dietsche’s (1990) model is a longitudinal process model with four categories of variables – background, entry level, interaction and outcome – assumed to be linear and additive consistent with Tinto (1975) and Bean (1980). First-year students were surveyed during the first week of class and again approximately eight weeks later mid-term. Each survey had approximately 100 multiple choice and Likert-type questions about students’ attitudes, perceptions and behaviour. Categorized by group membership differentiated by the variables above, the results identified successful and unsuccessful persisters and successful and unsuccessful leavers based on institutional measures of grade point average (GPA) and whether the student returned for second or third term. The model accounted for 25% of the variance between groups. Consistent with Metzner and Bean (1987), with the students who participated in both surveys, Dietsche (1990) found academic integration more important than social integration and goal commitment more important than institutional commitment. Consistent with Tinto’s (1975) model, factors relating to institutional and goal commitment were measured on both surveys. Changes in these variables were interpreted as relating to the student-institution interaction, where Dietsche suggested the institution could have an impact. For both successful and unsuccessful leavers, there was a loss of confidence in success, decreased educational and institutional commitment and increased job orientation. Dietsche (1990) suggested dropping out was a cumulative process; academically successful students left the college as a result of negative experiences with the college and program of study, perhaps related to insufficient academic challenge; unsuccessful dropouts left the college as a result of discouragement and lack of preparedness. Dietsche (1990) concluded by arguing for substantial investment in data management systems to track and produce this type of information for administrators to use to make institutional changes to increase retention in a climate of declining enrolment.
The strength of Dietsche’s (1990) model is the incorporation of multiple evaluations over time of student attitudes and perspectives, to measure change in those attitudes and perspectives possibly attributable to the student-institutional interaction. Dietsche’s research, conducted with a primarily commuter student population, accounted for less of the variance between groups than did Metzner and Bean’s (1987) although both models included similar variables. The difference may be attributable to the different populations – part-time students (Metzner & Bean, 1987) and full-time students (Dietsche, 1990) and/or to the different contexts of a U.S. university and an Ontario primarily vocational institution with one to three-year programs. The portion of the variance accounted for means that the data are consistent with the relationships postulated in the model, not that the relationships are causal. Seen from a different perspective, Dietsche’s (1990) and Metzner & Bean’s (1987) models failed to account for 75% and 71%, respectively, of the drop-out variance between student groups which suggests dropping out is a more complex process than conceptualized.

Similar to much of the institutionally-based retention research, Tinto’s (1975), Metzner and Bean’s (1987) and Dietsche’s (1990) studies relied on survey information with all of the inherent limitations. Students self-select for participation and, depending on the questions asked, may or may not respond accurately particularly to retrospective questions. Porter and Whitcomb (2005) conducted research on the relationship of demographic, academic, student engagement, personality and previous survey behaviour as predictors of non-response in student surveys at one U.S. liberal arts college. Institutional data for a random selection of full-time, first-time degree students were matched to data from the pre-college surveys of the Cooperative Institutional Research Program of the Higher Education Research Institute in the United States. The research minimized the impact of survey topic on response rates through the use of four web-based surveys focused on different aspects of the college experience – food services, alcohol and drug use, behaviour linked to student engagement and student satisfaction. Findings showed that 14% of students participated in all of the
surveys while at the other extreme, 29% did not participate in any. Porter and Whitcomb (2005) concluded that consistent with previous research on survey non-response rate, “in most populations a significant proportion of people never participate in a survey” (p.138). Characteristics relevant to a higher response rate included being female, having a higher GPA, being socially engaged and scoring high on investigative personality type. Those related to non-response included being male, having a lower GPA, receiving financial aid, being less socially engaged and scoring high on artistic and enterprising personality types. Although these results may not be generalizable to other student populations at other PSE institutions, given that much of institutional research is survey-based, they do suggest that institutions should be cautious in how survey results are interpreted and relied upon to identify students at risk or in developing or measuring the success of retention initiatives.

I administered the FITS surveys described by Dietsche (1990) to my first term students at Humber for several years in the mid-2000s. There was little communication between administrators and faculty about the purpose, value, or use of the information collected. As a result, faculty provided limited context for the surveys to the students. The questionnaires were long, requiring approximately half an hour to complete more than 100 personal questions, during the first week of class when students had just begun to adjust to the PSE environment. The surveys formed part of the early student experience at Humber. Could the experience have been perceived as intrusive rather than supportive; alienating rather than integrative? Some students treated the surveys as a chore. When presented with the second questionnaire six to eight weeks after the first, some students expressed irritation and impatience, complaining that they had already answered the questions once, why did they have to do it again. Is it possible that one or more of the survey questions affected student goal or institutional commitment and thereby contributed to or detracted from student persistence within the institution?
Two assumptions underlying Tinto’s (1975), Metzner and Bean’s (1987) and Dietsche’s (1990) models of PSE student persistence are problematic. The first relates to how the models identify students perceived to be at risk of dropping out by student entry characteristic such as parental educational status. The second relates to how responsibility for student retention measures is implicitly placed at the level of administrators within an institution. Regarding the first assumption, I question the reasonableness of targeting populations by background characteristic in order to provide specific forms of assistance. That specific forms of support will match specific identified groups of students assumes a level of uniformity in student needs based only on membership in a specific segment of the population. Recent research indicates there are significant within-group differences (Anisef et al., 2008; CCL, 2008a; Finnie, Childs, & Wismer, 2011a; Kim et al., 2010; McAndrew et al., 2009). Research also indicates that even subtle differences in student characteristics such as feelings of not belonging appear to have a significant impact on the student experience (Lehmann, 2007). However, arguably as a result of the foundational status of Tinto’s (1975) theoretical model, this assumption continues to permeate the literature and institutional discourse on student persistence and attrition. Educational success or lack thereof is seen as related to for example, sex, first generation status, ethnicity, socioeconomic status and urban or rural residency. Policy and practice continue to concentrate institutional retention efforts at the level of groups perceived to be at risk rather than at the level of the individual student, whereas social and academic integration are seen to occur for each student as a function of individual relationships and experiences. It is difficult to see the congruence between institutional action targeted at the group level and the need for integration on a personal individual level.

The second aspect of concern is the assumption that action at the administrative level within an institution will increase student academic and social integration. Given the structure of higher education institutions, student services (including admissions, enrolment, registration, counselling, and financial aid) are managed separately from academic schools, programs, and related advising.
Academic integration is related to the academic experience and efforts of students both in and out of class. Social integration is related to social opportunities on campus with peers and as provided by student services, students’ federations, and clubs. Articulating the responsibility of integration at the administrative level has been interpreted at Humber as relating to those operational areas centralized within the organization which are relevant to social integration. And yet research with commuter students including those within Humber, has found that academic rather than social integration is more relevant to persistence. As a result, retention efforts may be targeting the wrong dimension of integration and the wrong location within the institution.

The theoretical models developed by Tinto (1975) and Bean (1980) are foundational to Dietsche’s (1990) research on student retention in the Ontario community college system, and form part of the institutional fabric of Humber today. This is so even though Dietsche’s research with full-time students in 1988 may not be generalizable to students today given the diversity of the current student body and the different PSE context. As with most of the institutionally-based research on retention, these models focus on student persistence from first to second year, based on information that this period is where a greater percentage of students withdraw. They may not be relevant to students who leave later in a program of study. In addition, the short duration of tracking does not permit assessment of those students who return to the institution after the research period has ended. Implicit in these longitudinal path models of PSE student attrition is the assumption that the expected and normal path through PSE is linear and unbroken. Part-time enrolment and non-continuation of enrolment, temporary or otherwise, particularly within the first year, is a deviation from the norm and the result of ineffective or inadequate institutional response.

Tinto (1993) extended his original model (Tinto, 1975) to more specifically include the influence of communities both within the classroom and external to the institution (see Figure 4) to reflect more recent research. Similar to the original conceptualization (Tinto, 1975) however, the core
assumptions and the linearity of the model did not change. Tinto’s (1975, 1993) theoretical framework remains central to retention research today. Per Google Scholar, Tinto (1975), the initial conceptual framework, has been cited more than 4,600 times and Braxton (2000) has referred to the model’s “near paradigmatic stature” (p. 2). As an example of recent research, Ma and Frempong (2008) utilized Tinto’s (1993) framework to analyze PSE attrition in Canada in their research based on data from the first three cycles of YITS. They found that an overall measure of PSE integration with both social and academic aspects was more important than secondary school factors to the incidence of students leaving PSE and concluded the results of the study generally supported Tinto’s (1993) model.

Figure 4: A Longitudinal Model of Student Departure

Figure 4: A Longitudinal Model of Student Departure

More recent theoretical models build on the earlier models by incorporating other student measures and/or extending the models to different student groups. Examples include Côté & Levine’s (1997) integrated paradigm of student development based in part on Astin (1993) and incorporating measures of motivation discussed above, and Crisp and Nora’s (2010) theoretical model of persistence and transfer for Hispanic community college students in the United States based in part on Tinto (1993).

As a result of the extensive research based on data from the Canadian national level YITS, Finnie, Sweetman, and Usher (2008) have created the Full Model of PSE Causal Pathways (Figure 5). Compared to the models developed by Tinto (1975, 1993), Bean and Metzner (1985), and Metzner and Bean (1987), utilized by Dietsche (1990), this model is more comprehensive in that it gives added emphasis to aspects of student experience seen as relevant from a life course perspective such as early family environment and experiences and high school experiences. Once the PSE stage has been reached however, family, community and other influences do not appear to have other than antecedent affect and PSE is depicted as removed and separate from external influence and other life events. However, the normalized transitions to adulthood navigated by young men and women, mapped by Clark (2007) and discussed below, do not generally happen sequentially with one transition completed before another one is begun for all individuals. Many participate simultaneously in more than one life sphere (Andres, 1999), while constrained by institutional rigidity. As persistence within PSE is a dynamic process, these external influences still operate. Choice and agency must be exercised continuously in favour of persistence in PSE despite the multiple roles today’s students juggle and the competing demands on their scarce financial and other resources.
The expectation of the student-institution relationship as a closed system continues to reflect the historical, traditional student as a young adult able to attend PSE full-time with little in the way of
family and other responsibilities competing for time and energy. Missing are the multiple transitions that many students are making concurrent to pursuing PSE: starting and raising a family, being financially independent of parents, entering the job market. Larger economic and political factors do not form part of any of the models.

The closed system frameworks of this and earlier models of PSE student pathways continue to inform practice at Humber, historically and through the concept of student engagement, the current focus of PSE institutional effectiveness regarding student success. Student engagement is defined by NSSE as “the amount of time and effort students put into their studies and other educationally purposeful activities” and “how the institution deploys its resources and organizes the curriculum and other learning opportunities to get students to participate in activities...linked to student learning” (NSSE, 2014). It is considered by NSSE to be a key indicator of learning and therefore of the quality of an institution. NSSE, developed in 1998, is based in part on research on Tinto (1975, 1993) and Astin’s (1970a, 1970b, 1993, 1999) models. The survey, administered to randomly selected, primarily full-time, first-year and senior students at degree-granting institutions measures student engagement along five benchmarks – Level of Academic Challenge, Active and Collaborative Learning, Student-Faculty Interaction, Enriching Educational Experiences, and Supportive Campus Environment. It has been widely used in four-year colleges in the United States and in many Canadian universities and is considered and reported as an institutional-level measure (NSSE, 2014).

The concept of student engagement has been embraced at the central administrative level within Humber. Student Services has been renamed Student Success and Engagement, part of the Student and Community Engagement portfolio. Over the past few years, there has been an increased emphasis on orientation activities for first term students including events for students who are members of groups perceived as at risk of dropping out, for example, First Generation Students,
Mature Students, and Aboriginal Students. There is however, little empirical evidence relating student engagement to retention and graduation. Gordon, Ludlum, and Hoey (2008) evaluated NSSE benchmarks against student success measures including retention and GPA at one highly-selective U.S. institution. They found the benchmarks "only very loosely related" to these outcome measures (p. 37) and suggested that NSSE was limited as a measure of institutional effectiveness, although these results are not generalizable to other institutions.

Humber administered the partner Community College Survey on Student Engagement (2012) to 1,030 full-time certificate and diploma students in 2009. Mandarino and Mattern (2010) explored the validity of the instrument in the Ontario college environment based on the resulting data and analyzed the relationship between survey benchmarks and various measures of academic outcomes including term GPA, cumulative GPA and percent of courses completed with a grade higher than 70%. Mandarino and Mattern (2010) confirmed the validity of the assessment instrument to measure student engagement as conceptualized. After controlling for student background characteristics including age, sex, ethnicity, 1st generation status, and secondary school GPA, only two of the five benchmarks, Active and Collaborative Learning and Academic Challenge, were identified as predictors of some of the learning outcomes.

Current Canadian research on NSSE, the NSSE National Data Project (Conway & Zhao, 2012; Conway, Zhao, & Montgomery, 2011), is focussed on developing academic program and student-level measures for individual institutions and models to estimate how student characteristics, program mix and institutional characteristics relate to student engagement. Analysis of the approximately 69,000 student responses for NSSE in 2008 and 2009 from 44 Canadian universities demonstrates variability in student characteristics and program mix by institution as well as significant differences in measures of engagement both across and within groups of programs as well as across student subgroups. Regression models of relationships among student, program, and
institution characteristics and measures of engagement show that all contribute to variation in engagement scores. Controlling for these factors reduces inter-institutional score differentials (Conway, Zhao, & Montgomery, 2011). Conway, Zhao, and Montgomery (2011) conclude that "engagement and attrition are strongly correlated, and that numerous student, program and institutional factors predict attrition" (p. 39) however, the data were insufficient to identify the parameters or direction of any "engagement-attrition" relationship. Further analysis of program and student-level engagement variation showed significant program-level differences within engagement survey items for different student groups identified by characteristic, suggesting that improving student engagement was best directed toward and within, specific academic programs (Conway & Zhao, 2012). This research underlines the importance of program-level and student-level factors on institutional measures of student engagement and therefore the importance of understanding individual student context.

**Postsecondary Education – A Life Course Perspective**

The broadest perspective of individual student context situates the postsecondary educational experience within the course of a lifetime from birth to death. From this vantage point the interrelationships of past, present and future, or "path dependence" (Heinz et al., 2009, p. 16) can be seen. In addition, the life course perspective highlights the "multi-dimensionality" of this path relating to family, education, work, and leisure with a corresponding competition for individual resources, situated within macro level economic, political, social, and cultural, and meso level institutional contexts (Heinz et al., 2009, p. 16). Life course research “acknowledges conceptually that paths are complex, nonlinear, disordered, and fluid” (Andres, 1999, p. 150).

The life course of young adult students over the past decade is seen as characterized by "discontinuity and disorder" (Heinz et al., 2009, p.19). Expected timeframes and ages no longer define a typical pathway from school through PSE to the workforce and starting a family.
Globalization has rendered the job market less structured and provided individuals with more options to pursue. This has occurred concurrently with increased specialization and choice at all levels of education. PSE has become increasingly perceived as preparation for employment and valued and evaluated accordingly. The risk of adverse consequence is largely private, mediated to some extent by the particular political and social national system. In Canada, links among education, credentials, and labour markets are comparatively loosely coupled and supportive of market flexibility, relative to other countries where connections are more regulated such as Germany (Heinz, 1999). This increases private risk from the exercise of individual choice. Without strong connections between educational pathways and the job market, lack of success is seen as the result of individual failure.

Research by Clark (2007) based on Statistics Canada longitudinal census data of young adults ages 18-34 from 1971-2001, shows that recent timing of youth to adulthood transitions has significantly changed compared to earlier decades, particularly for males. In 1971, by age 25 young adults had made slightly more than three of the five expected transitions. In 2001 this had fallen to slightly more than two (Figure 6). With the data disaggregated by sex (Figure 7), although males have consistently lagged females in the number of transitions made, the gap has increased between 1971 and 2001. Longitudinal research by Andres (Andres & Wyn, 2010) in the Paths on Life’s Way study in British Columbia provides empirical support regarding the altered transitions for young adults, including postponement of partnering and family formation and an extended period of relying on parental support particularly for young adults from university-educated parental backgrounds.
Figure 6: Average Transitions by Age, 1971-2001

![Chart 1: Young adults have made fewer transitions](image)

Source: Statistics Canada, Censuses of Population.


Figure 7: Average Transitions by Age and Sex, 1971 & 2001

![Chart 2: Today’s young women have made more transitions than men by their mid-20s](image)

Source: Statistics Canada, Censuses of Population.

Current transitions of youth to adulthood are commonly portrayed as lacking. Clark (2007) identifies them as *delayed*, a characterization which is contested. Andres and Wyn (2010, chapter 2) challenge it as inaccurate because of the implicit normative assumptions embedded in the comparator transitions of the baby boom generation in the 1970s without consideration of the distinct economic and social context which existed at that time, the diversity of experience within social generation patterns generally, and, more fundamentally, to limitations with the concept of *transitions*. Clark's characterization is also criticized as reflecting minimal periods of comparison and a lack of understanding of the diversity of comparator periods. Côté and Bynner (2008) note that longer transitions are not unique to the current generation of young adults; transitions in the 19th century were similar; Oppenheimer (1997) has described the behaviour of the postwar baby boom period as "historically atypical" (p. 431); and research by Goodwin and O'Connor (2005) shows that the transitions of the 1960s-1970s were more complex than generally understood and commonly described today.

The concept of delayed transitions for today's youth is also represented in the literature, for example, in Arnett's (2000) theory of emerging adulthood as a new and discrete stage of psychological development from ages 18-25 "distinguished by relative independence from social roles and from normative expectations" (Arnett, 2000, p. 469), and described as "a time of life when many different directions remain possible, when little about the future has been decided for certain, when the scope of independent exploration of life's possibilities is greater for most people than it will be at any other period of the life course"(p. 469); a theory which is also contested. Byner (2005) describes it as relating to a chronologically age-restricted developmental stage and argues for a broader life-course conceptualization which considers the structural economic, cultural and social constraints on individual agency and experience. Hendry and Kloep (2007a; 2007b) disagree that Arnett's (2000) conceptualization of development from age 18-25 is a theory, and state that he is "simply describing the effects of certain societal conditions on certain individuals belonging to a certain cohort" and
suggest "we should better understand and investigate the interactive processes and mechanisms (of which societal transformation is only one) that are involved in human development." (2007a, p. 78). Cote and Bynner (2008) also suggest that Arnett (2000) is mischaracterizing young adult "coping mechanisms" as "freely chosen options" (p. 251) and state "[o]ur proposition is that conceptualizing the stage of life described as emerging adulthood requires greater recognition of population heterogeneity and the structural components of it, including those leading to traditional, but now marginalized, adult statuses"(p. 256). Empirical research supports this lack of homogeneity and concludes that the concept of emerging adulthood appears to operate at the level of the sub-group (Hendry & Kloep, 2010) and is culturally dependent (Galambos & Martinez, 2007).

Characterizing current transitions of youth to adulthood as delayed or as a normal stage of psychological development suggests that the length and timing of transitions are related to individual personal characteristics and choices, and minimizes the structural, social and cultural constraints faced by many young adults today. Ages of transitions are influenced by historical and social change, including changes in employment opportunities. The job market of the past two decades has become more unstable, with increased short-term contract work without benefits, more part-time jobs, and a growing wage discrepancy with older workers (Clark, 2007). High school students are encouraged to begin to explore future careers as early as grade 9; a time when students are also required to choose between applied and academic course streams and the dominate narratives include both the importance of a university degree to future job prospects and the devaluation of a degree in the job market. Many students likely enrol in PSE by necessity rather than a fit with academic skills or because they are interested in a program of study, in learning and being engaged with the material.

Côté & Bynner (2008) assert that PSE outcomes have become more uncertain. Coupled with the instability of the job market, there is more emphasis on individual agency in choosing, planning, and
navigating from available pathways. Many students face constraints which impede their ability to take full advantage of the opportunities they are presented with and are disadvantaged regarding obtaining full-time employment with sufficient remuneration to support the level of independence associated with being adult. Overall, the transitions of youth to adulthood are characterized by a high degree of variability and fewer social norms. This is in contrast to the regularized expectations underpinning the student retention models developed in the 1970s-1980s still relied upon today; models which are arguably also reflective of the specific context of the baby boom generation.

**Empirical Research on Persistence from a Life Course Perspective**

In preparation for this part of the research study, I undertook a systematic and documented literature review. I also searched for review articles and meta-research studies into PSE student persistence. Finally, I searched grey literature sites. To narrow the focus for the purposes of this study and in recognition that student success is highly context dependent, I excluded research before 2000 as well as research from countries other than Canada. Although a substantial body of research exists on postsecondary student success, there is much less on student persistence in PSE.\(^2\) Student persistence is a dynamic process over time and few studies are sufficiently longitudinal to capture the nature of that process. Andres’ Paths on Life’s Way project (Andres & Wyn, 2010), a 22 year study following the 1988 high school graduating cohort in British Columbia, is a notable exception as the longest longitudinal study tracking student pathways from high school to PSE and work and examining individual experience through multiple life spheres. Grayson and Grayson (2003), in their review of the literature, noted the dearth of Canadian literature in this area. What research did exist employed Tinto’s (1975, 1993) student integration model. Grayson and Grayson (2003) described

\(^2\)For a comprehensive review of the Canadian and Quebec literature regarding student PSE transitions and pathways including the research highlighted here, as well as relating to financial factors, and theoretical explanatory perspectives, see Diallo, Trottier, & Doray (2009).
the body of research on student persistence as "characterized by inadequate conceptualization and operationalization, small sample size, low response rates and the utilization of inappropriate statistical techniques" (p. 2).

Usher and Potter (2006), in their state of the field review of PSE for the CCL summarized the retention research in one page with reference to the dominant theoretical frameworks of Tinto (1975, 1993) and Bean and Metzner (1985), and the literature review of Grayson and Grayson (2003), and asserted that

[M]any of the issues in student retention are the same as those for access, in that many of the same types of people who have a difficult time accessing post-secondary education (e.g. low-income, first-generation and minority students) also have a difficult time completing post-secondary education. (p. 26)

EPI (2008) prepared a comprehensive literature review on access, persistence and barriers in PSE for HEQCO. Coverage and conclusions regarding student persistence echoed those of Grayson and Grayson (2003) and Usher and Potter (2006) and noted that several student groups, including Aboriginal students in particular, faced challenges completing PSE.

Parkin and Baldwin (2009) summarized the more recent Canadian findings on PSE persistence at the national level based on YITS (outlined in more detail below), which permits tracking of two samples of students between institutions over time. Commenting on previous studies, Parkin and Baldwin (2009) noted, “Different studies tend to offer somewhat different portraits of the attributes and factors associated with dropping out” (p. 7). The YITS research to that point identified that Aboriginal students, males, older students, and students with dependent responsibilities were more likely to leave PSE prior to completion. Persistence was also related to secondary and postsecondary academic performance and measures of student engagement. Parkin and Baldwin (2009) suggested that PSE institutions needed “to identify their students from backgrounds that
might lead them to experience challenges along the route to graduation and provide them with support programs created for and tailored to them so that they can…succeed” (p. 13).

Scholars generally agree that student success in PSE is contextual, related primarily to the nexus of student and institution (EPI, 2008; Grayson & Grayson, 2003; Parkin & Baldwin, 2009; Usher & Potter, 2006). Given the significant differences between the PSE systems of the United States and Canada, the extensive U.S. research on student retention and persistence provides little empirical support for the nature of student persistence in Canada. Contextual difference also renders research in other provinces less relevant to an Ontario institution (Finnie, Childs, & Wismer, 2011a; Finnie, Childs, & Wismer, 2011b) and university-based research less relevant to a community college setting. My focus is therefore on the most recent longitudinal research of PSE student persistence and pathways in Canada, in particular, those studies which disaggregate Ontario college students from university students and postsecondary students in the rest of Canada. Wherever possible, I have included empirical studies regarding students in the GTA.

Much of the relevant research regarding the dynamics of the postsecondary experience of Canadian youth is based on data from YITS (Human Resources Development Canada, 2000). YITS, developed to provide information on school-postsecondary-work transitions and pathways, has followed two cohorts of Canadian youth longitudinally since 2000. Young Canadians in cohorts A and B, ages 15 and 18-20 respectively at the time of the first cycle in 2000, have been surveyed bi-annually on educational experiences and life factors. The two datasets track individual students as they enter PSE and either graduate, leave, leave and return, and/or change institutions and/or programs. The datasets also include variables relating to student demographic characteristics, secondary school academic and social experiences, and postsecondary educational experiences. Since 2000, numerous studies have been published based on the YITS datasets. Although very rich in detail and providing both provincial and national systems level perspective on the Canadian PSE.
experience, the YITS datasets have several inherent limitations. They are limited by selection and response bias, and by sample size particularly when results are disaggregated to the provincial and student group level. As well there is a lack of institutionally specific information at both the secondary and postsecondary levels (Finnie & Qiu, 2009).

In this section I present the research organized from an educational trajectory perspective beginning with secondary school, through application to and enrolment in PSE, and ending with academic pathways and persistence within PSE with the goal of identifying characteristics along the trajectories which might be used as predictors of individual student persistence and successful academic pathways and outcomes. I first provide an overview of the most recent and relevant Canadian research on secondary school trajectories and transition to PSE. This is followed by a review of the research relating to aspects of the student-institutional interaction at the time of application and entry into PSE where arguably institutional-specific predictors of those pathways might be found. I conclude with a review of literature relating to student PSE academic pathways and persistence, particularly regarding Ontario colleges. My focus is on facets of the student success research relating to information readily available to PSE institutions. Although I have argued that a focus on student group membership is not helpful in supporting students in PSE, the research continues to focus on student demographic membership and, therefore, the review which follows, is initially structured accordingly.

Secondary School Trajectories and Transition to PSE

PSE, from a life course perspective, is seen as a pivotal opportunity, providing individuals with the possibility of changing the direction of the life course they have experienced to that point (Elder & Giele, 2009a). When students arrive in PSE, each brings his or her unique characteristics and experiences, many of which may present as opportunities and constraints for academic success. Each enters already on a formal educational trajectory, its genesis at Kindergarten or before, and
with extensive experience in the K-12 system in Canada and/or one or more other countries. These experiences, together with those of family and community, have profoundly shaped each student’s own expectations of educational institutions and his or her beliefs, aspirations, and expectations about PSE and career opportunities.

Canadian young people of various cultural identities differ substantially in their educational aspirations, academic effort and academic performance. They also come from homes that differ considerably in socio-economic status and cultural features, with their associated advantages and disadvantages (Thiessen, 2009, p.6).

Beginning in 2003 the Ontario secondary school system has undergone significant change in supporting students to graduation. The provincial government’s Student Success/Learning to 18 Strategy (Ontario Ministry of Education, 2012) provides students in grades 7-12 with the ability to craft a high school program based on individual strengths, goals and interests, through increased credit recovery options, co-op education credits, dual credit opportunities and increased institutional flexibility and student support. This strategy has been evaluated as successful in changing the culture within the Ontario secondary system, increasing high school graduation rates. Stakeholders perceive the secondary system as supporting smoother student transitions to work or PSE after high school graduation (CCL, 2008b).

Although a high school diploma has not historically been considered as synonymous with readiness for PSE, this no longer appears to be the case. Consistent with Trow’s (1973) conceptualization of a mass to universal PSE system, the social, political, and economic emphasis on the importance of PSE for Ontario’s future prosperity means there is now an expectation that most, if not all, high school students will continue their education post-graduation. This imperative underpins the government’s prioritization of increasing high school graduation rates and increasing access to PSE through expansion of the PSE system over the past decade. Many students however, appear
unprepared for postsecondary level study. To the extent a readiness gap exists, it is left to individual PSE institutions to manage through admissions policies, remedial, or foundation level courses and provision of student support services. Many of the costs of delayed or unsuccessful PSE transitions are borne personally by individual students.

Also consistent with Trow's (1973) conceptualization, students take diverse paths to PSE. The traditional route is high school graduation in June immediately followed by full-time PSE three months later in early September; however, many college students do not follow this historical pattern.

In this section I review the research on student pathways to PSE by student pathway and by student characteristic. Research on access and persistence in PSE has focused on student groups identified by student characteristic, particularly those student groups differently represented in PSE compared to the group representation in the overall population. As detailed in their state of the field review (EPI, 2008), the student population is generally disaggregated to the group level based on sex, with or without disability, first generation, race, ethnicity, immigrant status, visible minority, first language, Aboriginal status, family type, income level, and rural or urban. As will be seen, different student groups do experience diverse transitions and pathways to PSE, however variability is evident within student groups, and there is cross-membership across student groups. The research also confirms the findings of the national study of first year college students conducted in 2005 regarding the diversity within student populations (ACCC, 2008). Colleges are host to significant numbers of Aboriginal, visible minority, and immigrant students and students with disabilities.

**Differentiated paths.** It is clear that students take many different educational paths from high school to the labour market. Andres and Offerhaus (2013) identified 540 unique sequences through PSE and into the workforce by 540 Path’s on Life’s Way participants in 22 years. Hango (2010), using data from the first five cycles of the YITS-B dataset identified thirteen different
educational pathways, ten of which included PSE. Of the PSE pathways, five related to direct entry students and five related to students who experienced a "non-linear route" (p. 14).

Research based on data from the 2004 College Applicant Survey (Colleges Ontario, 2005) shows that students applying to Ontario colleges follow one of three identifiable pathways: direct from high school, to college after being out of school for at least one year, or after some previous PSE. Direct entry applicants tended to have family incomes higher than for those on the other two paths, and were more likely to have at least one parent with college experience. A large majority of applicants in each group made the decision to attend college after the age of 15. More than 50% of the delayed applicants were under the age of 20 whereas approximately 45% of applicants with previous PSE experience were over age 25. A higher percentage of applicants with previous PSE experience had dependents and approximately 6% of all applicants reported a disability. Within the GTA, 36% of applicants were direct from high school, less than the provincial average of approximately 40%.

Although Canada’s educational system is relatively open and undifferentiated (Buchmann & Dalton, 2002), streaming does exist within secondary schools in Ontario. Information about secondary school pathways and the secondary school-to-PSE transition highlights how streaming affects student decisions about PSE options. Survey research (King & Warren, 2006) of more than 21,000 grade 11, 12 and Year 5 students from 73 Ontario secondary schools in 2005-2006 on PSE planning found approximately half of direct entry students had enrolled in university preparation courses in grades 11 and 12 rather than college preparation courses. Grades were an important indicator of ultimate PSE destination. Most university bound students had grades above 80%; most college bound students had grades below and often significantly below that level. More students considered at risk of not graduating from secondary school identified themselves as planning to attend college. There were no significant sex differences for students who planned to attend college although average grades for male students were lower than for female students. In schools where more
students planned on attending university, students indicated that the school emphasized university preparation over college preparation. A significant portion of students across Ontario, approximately 40-47%, expressed uncertainty that a college credential was perceived by society as valuable. In the GTA, significantly fewer students planned on attending college and students were more likely to value a university education over a college education (King & Warren, 2006).

Sattler, Academic Group Inc. (2010) explored pathways of Ontario students from groups under-represented in PSE from the time of application to PSE to the labour market. The student groups identified as underrepresented in PSE for this study were students who self-identified as Aboriginal, as a student with disabilities, or as a first generation student whose parents did not complete PSE, and non-direct students who do not attend PSE immediately after high school graduation. A sample of 4,029 college and university applicant participants of Academica Group’s University and College Applicant Survey™ during the period 2005-2009, 9% of eligible participants, agreed to participate in a further PSE Outcomes survey. Five PSE pathways were identified differentiated by PSE application outcome – students who were not offered admission to PSE, students who declined an offer of admission, students in attendance at PSE, students who had participated in PSE and left before completion, and students who had participated in PSE and completed a credential. Students from under-represented groups were more likely to have applied to college than to university. Figure 8 shows diverse pathways for students who are members of underrepresented groups, defined as Aboriginal – those who self-identified as First Nations, Métis, or Inuit; Disability – those who considered they had a physical, mental or learning disability; First-generation PSE – those without a parent or guardian who had completed any PSE program; Delayed entry – those older than age 19 without PSE experience; Non-designated – those who did not belong to one of the other four groups.
Research by Finnie, Childs, & Wismer (2011b) on access of underrepresented groups in PSE in Ontario (low-income, first generation, rural, first and second generation immigrant, Aboriginal students and students with a disability) based on the cohort A of the YITS dataset confirms that parental education level is an important determinant of access to PSE in Ontario, more so than in other parts of Canada and more so than household income. Aboriginal youth, rural youth and youth with disabilities are underrepresented in PSE and have higher college participation rates than university participation rates. Children of immigrants have higher PSE participation rates than non-immigrants and are not therefore underrepresented in PSE in Ontario and have lower college participation rates and higher university participation rates than children of non-immigrants. Females have higher PSE participation rates, particularly in university, however female members of underrepresented groups across Canada have lower participation rates.

**Non-direct entry students.** Research based on the 2007 National Graduates Survey of the graduating class of 2005 (Bayard & Greenlee, 2008) found more college graduates than university
graduates had delayed their participation in PSE after high school, clearly demonstrated by the average graduating age of 26 for both college and bachelor degrees although the average length of college programs, 21 months, is significantly shorter than that of bachelor degree programs, 39 months. Male students are more likely to postpone PSE than female students and Aboriginal students are more likely to be non-direct entry students than non-Aboriginal students (Hango & de Broucker, 2007). Sattler, Academica Group Inc. (2010) in her research on underrepresented groups also found that male students were much more likely than female students to take time away from education between secondary and postsecondary school, particularly male students applying to college. The incidence of disability was higher with non-direct entry student applicants than direct entry student applicants, and non-direct entry applicants were more likely to have lower entry GPAs (Sattler, Academica Group Inc., 2010).

Research (Colleges Ontario, 2008) focused on non-direct applicants to Ontario colleges in 2007-2008, profiles these students by entry pathway – no previous PSE experience, some college or university experience without graduation, or a previous PSE credential. Demographic differences by pathway were evident, as were regional differences across Ontario due to diverse regional population patterns. Approximately 30% of the delayed entry students with no previous PSE had achieved a secondary school GPA less than 70% and thirty-one percent did not take a mathematics course in grade 12. This group also had a higher proportion of males, of Aboriginal students, and a high proportion of students with English or French as a second language. Significantly more students in the GTA colleges reported a first language other than English or French. Reported reasons for attending college were diverse. The most common responses for all groups in the GTA colleges were to prepare for career/employment and to prepare for further college or university study.
More recent research (King, Warren, King, Brook, & Kocher, 2009) tracking Ontario students from grade nine in 2001-2002 and 2002-2003 through to college applications, offers and acceptances in 2005-2006 and 2006-2007, also showed that fewer than 40% of new college entrants come directly from secondary school. Secondary school students decide as early as grade 9 whether to take college or university designated courses, a decision that appears to relate to the choice and timing of PSE path. Students who took Academic English or Mathematics in grade 9 are much more likely to complete high school and enter PSE than students who took Applied or Locally Developed English or Mathematics. The number of failed courses in grades 9 and 10 was related to completion of high school within five years and student grades in grade 9 were strongly related to high school completion. Students who registered in college after high school had lower average secondary school grades than those who headed to university and there was little difference between the average grades of students who went directly to college from high school and those of students who delayed. There were no sex differences in the percentages of female and male students who transitioned directly to college; however, fewer male students completed high school in five years. Male students were less likely to have taken courses designated as Academic in grades 9 and 10 or University-preparation courses in grades 11 and 12, and they generally achieved lower average grades than female students in all high school English, Mathematics, and Science courses other than grade 9 Locally Developed Mathematics (King et al., 2009).

Research by Thiessen (2009) based on data from the first two cycles in 2000 and 2002 of YITS cohort B, age 18-20 in 2000, explored how population group differences in initial educational pathways related to cultural (academic effort, alcohol/drug use, university expectations and aspirations, importance of PSE to parents, peer PSE plans, bilingual and ESL/FSL status) or structural (parental education level, parental occupation, number of parents, number of siblings, maternal employment, private high school) factors. Immigrant and Canadian-born students disaggregated by ethnic or visible minority status were grouped based on the similarities in their
initial educational pathway categorized as *no PSE, community college, or university*. Thiessen (2009) found that educational pathways differed significantly among population groups with Aboriginal youth least likely to pursue PSE, and East Asians, both Canadian born and immigrant, most likely to pursue university and least likely to pursue non-university PSE. More than 40% of African and Latin American youth, Canadian born and immigrant, enrolled in community college. The different population groups also differed in cultural characteristics, structural location and in prior academic performance, however these factors did not account for all of the difference in educational pathways between the groups of youth (Thiessen, 2009).

**First generation students.** The concept of the first generation student, initially adopted from the United States (Auclair et al., 2008), is generally defined in Ontario as a student whose parents have not attended PSE, although definitions within institutions and the literature are inconsistent. Students whose parents did not participate in PSE are more likely to apply to college than to university (Shaienks, Gluszynski, & Bayard, 2008). First generation students are also more likely to delay applying to PSE after high school compared to PSE applicants overall (Sattler, Academica Group Inc., 2010). Based on the Longitudinal Survey of Low Income Students conducted in 2007, 2008 and 2009 of the 2006 cohort of single dependent students first enrolling in PSE, with parents’ income below the National Child Benefit line – from Newfoundland & Labrador, Nova Scotia, New Brunswick, Ontario (69%), Manitoba and British Columbia (14%), and receiving financial aid in first year (n=3609), Finnie, Childs, and Wismer (2010), found that first generation students tended to make their decision to attend PSE later in secondary school, were less likely to say they always knew they would participate in PSE than other students, devoted less time to studying than other students and had slightly lower GPAs. First generation students are more likely to attend college, and female students and students from rural areas are more likely to be first generation. First generation college students are more likely to be non-visible minority students born
in Canada compared to visible minority or immigrant students. Aboriginal students are also more likely to be first generation (Finnie, Childs, & Wismer, 2010).

**Urban and rural students.** The Canadian Council on Learning (2006) highlighted differences in urban and rural educational attainment in their review of the literature in this area. Not only are secondary school dropout rates higher in rural schools across Canada, but 2003 PISA results also showed student deficits in reading, mathematics and science for rural students compared with urban students. Evidence suggests this gap relates to characteristics of rural schools, community economic conditions, and lower student educational aspirations (CCL, 2006).

King et al. (2009) found significant differences in percentages of students applying and registering in PSE between school boards. Generally students from urban school boards were more likely to apply and register in PSE than students from rural areas and Northern Ontario. Those applying directly to college generally applied only to the institution in their community and even more so for non-direct applicants (King et al., 2009). For many college students, location rather than field or career salience of program may be the determining factor in enrolment. Research by Ontario Colleges (Franklin, 2011) shows students who apply to attend college after secondary school will apply to multiple programs at the proximate college in precedence to applying to a particular program at multiple institutions.

Sattler, Academica Group Inc. (2010) found significantly more students who applied to college came from less urban communities, particularly Aboriginal students, and non-direct students were less likely to be from less urban communities.

Research by Looker (2010) utilized data from the first four cycles of the YITS-A cohort to examine the relationship between available PSE options and PSE participation rates for urban and rural youth. Participation rates varied across different regions of Canada and differed for urban versus
rural youth. The urban versus rural differences related to differences in individual background characteristics and secondary school academic performance. PSE persistence did not differ significantly between these student groups (Looker, 2010).

**Aboriginal students.** National level survey research by the ACCC (2008) showed that Aboriginal students were more likely to attend college than university and that college was the first choice for most of the survey respondents. Aboriginal students were more likely to be female, older, have financial dependents, and be non-direct entrants (ACCC, 2008). King et al. (2009), in secondary school level research in Ontario, found that First Nation students were less likely to complete high school or enrol in PSE. Sattler, Academica Group Inc. (2010) identified Aboriginal PSE applicants compared to applicants overall as more likely to identify a disability at the time they applied to PSE, more likely to report lower GPAs, and more likely to delay PSE after high school or to transfer from another PSE institution.

**Immigrant and visible minority students and students with ESL/FSL.** ESL students were less likely than non-ESL students to complete secondary school and to enroll directly in PSE (King et al., 2009). Differences based on primary language were evident. Students whose primary language spoken at home was Spanish and Portuguese were less likely to enrol in PSE compared to students whose main language was English, French, or a language originating in China, Korea, Russia, and South Asia (King et al., 2009).

Qualitative interview research by the Hospital for Sick Children (2005) with secondary school students on the process of disengagement leading to dropping out of high school highlighted the difficulties faced by first and second generation immigrant youth. In addition to learning a new language, challenges include language barriers, lack of familiarity with the Canadian school system, and incorrect assessment and grade placement. The age at immigration was important. Students who were older at the time of immigration faced the greatest risk of dropping out of secondary
school. The study identified three disengagement pathways within the diverse student participant group, starting from scratch, mostly protected or in-between reflecting the balance of risk or protective factors faced by each student. Students faced both multiple risk factors and risk and protective factors simultaneously (Hospital for Sick Children, 2005, p. 1).

Research based on the Statistics Canada 2006 Census of Population long form data (Corak, 2011) of approximately 111,000 adults aged 35-55 who arrived in Canada before age 18, also shows relationships between age of immigration to Canada, source country, and the risk of not completing high school. For children who arrived in Canada before age 9, the risk of not graduating from secondary school was approximately 15% for males and 11% for females. For each additional year of age at immigration, the risk of non-completion increased by more than 1%. Immigrating to Canada after the age of 13 was related to a 20-25% risk of not graduating. This pattern of increased risk, postulated to relate to the increased challenge of learning a new language at an older age, was identified for students arriving from non-English and non-French speaking countries and varied according to the linguistic distance of the primary country-of-origin language from English or French (Corak, 2006).

Other research (Abada & Lin, 2011), based on both the 1996 Census and the 2006 Census, focused on the educational attainment, unemployment, and income of children of immigrants (also called 2nd generation immigrants who were born in Canada) aged 25-34 in Ontario and generation 1.5 children who immigrated to Canada when they were aged 12 or younger. This study shows diverse patterns of educational attainment related to immigrant generation, sex, and country of origin as compared with a reference group of 3rd generation Canadian-born children of Canadian-born parents (Abada & Lin, 2011).

Participants in the 2005 national survey of first year college students (ACCC, 2008) who self-identified as a recent immigrant having arrived in Canada during or after 2000, indicated that
university, not college was their first choice PSE destination. These recent immigrant students were most likely to be male, older, not be first generation in PSE, have financial dependents, and have a language other than English or French as their first language. Participants in this study who identified as visible minority and not a recent immigrant agreed that college was not their first choice PSE destination and reported more challenges in balancing multiple roles of responsibility, and course content and workload (ACCC, 2008).

Research on post-high-school pathways of immigrant students (Sweet et al., 2010), with TDSB student data, tracked students who were in grade 9 in 2000, until fall 2006. The study identified expected post-high school pathways based on confirmation of offers of acceptance to a PSE institution differentiated by college or university and high-school graduation status at the end of the research period. It is important to note that in recognition of the diversity of the immigrant student group, the study disaggregated results by generation of immigration (1st, 2nd or 3rd) and by source country. Postsecondary pathways were found to differ for students who migrated from different regions of the world. Students least likely to confirm acceptance to university and most likely to drop out of school entirely were born in the Caribbean, next, those born in Africa and Western Asia. Students from these regions were also more likely to enter the TDSB later than the norm. Students from the Caribbean were most likely to live in an alternate living structure and not with both parents and most likely to be enrolled in the Applied and Essentials streams rather than the Academic. Students from Africa and South Asia were most likely to live in low socio-economic areas of Toronto. Pathway analysis showed that differences in post-high school pathways were related to immigrant generation and region-of-origin. High school graduates from regions other than East Asia were more likely to confirm to college than to university or to not confirm at all. Individual student measures such as academic deficits, male sex and ESL status affected pathway choice. Measures of relative advantage representing available resources, family, neighbourhood, and course streaming were also related to PSE pathway (Sweet et al., 2010). Similar patterns of PSE pathways by generation of
immigration and region-of-origin have been identified at the national level based on data from the first four cycles of the YITS-A cohort (Finnie & Mueller, 2010).

**Students with special needs.** There is no question that the transition to postsecondary study, a less sheltered, more competitive, self-directed and adult-oriented environment than secondary school, presents challenges for many students. Students with special needs, including students with learning or physical disabilities, and students with less than optimal mental health face additional hurdles. Disability and health challenges can directly affect academic pathway and experience as evidenced by secondary to postsecondary transitions.

National level survey research (ACCC, 2008) shows that students with disabilities are more likely to apply to college than to university, are more likely to be male than female, have English as their first language, and are often older students with family responsibilities. Ten percent of first year college student respondents reported a disability and of these, most identified college as their first choice PSE destination. They were also more likely to self-identify as Aboriginal and less likely as a visible minority. First year college students who reported a disability also indicated experiencing challenges with course content and workload (ACCC, 2008).

Research on PSE pathways from PSE application to the labour market (Sattler, Academica Group Inc., 2010) indicates that compared to applicants overall, college applicants with disabilities are more likely to have lower entry GPAs, and are less likely to apply directly from secondary school.

Toronto-area research (Sweet, Anisef, Brown, Adamuti-Trache, & Parekh, 2012) on the PSE transitions of students with special needs utilized survey data from the Fall 2006 TDSB Student Census together with information on confirmed acceptances to PSE from the Ontario Universities Application Centre, OCAS, and TDSB data on all enrolled students. Analysis of PSE pathways of special needs students based on Thiessen’s (2008) resilience framework developed with low reading
score students, evaluated the students’ relative advantage or disadvantage as compared with other student groups including non-special needs students and non-special needs low-achieving students. The analysis found that 66% of special needs students were male and special needs students were more likely to pursue PSE at college than at university. Three-years after the expected graduation year 18.2% of special needs students had confirmed acceptance to university compared to 58.1% of non-special needs students and 23.9% had confirmed acceptance to college compared to 14.2% of non-special needs students. Special needs students were also more likely to be of some ethnic groups than others – more likely to be White or Black than Asian, for example. More special needs students than non-special needs students indicated they had difficulty with school and reported less academic engagement and lower academic achievement (Sweet et al., 2012).

It is clear that by the end of high school and at the time students enter PSE, they are already on diverse educational paths and have rich personal histories of academic experiences. The research shows there are both individual level factors and factors related to family, peers and community, including school community, which affect the high school experience of students and their post-high-school pathways. Much of the focus of this body of research is on student group demographic characteristics as related to academic pathway and outcome. There are two limitations to this approach. First, it is clear that pathways and outcomes are diverse within these student groups and that membership in a demographic group does not determine academic pathway within secondary school or at the point of transition to PSE. Demographic data alone are insufficient to differentiate between those students who persist in PSE and those who do not. Second, this approach is also limited by the fact that accurate and detailed student demographic data are not readily available at the PSE level. Available PSE institutional data on individual students are comprised of secondary school academic data provided by the schools, student demographic data provided by the student through the postsecondary application process, and PSE academic data generated by the student PSE academic experience.
This body of research on the high school to PSE trajectory suggests certain student and college entry characteristics where indicators of persistence, and future academic pathways and outcomes could be found: direct or non-direct from high school applicant; sex of student; ESL status; urban or rural high school community; Academic level or Applied level grade 9 and 10 English and mathematics courses and grades; university or college preparation grade 11 and 12 English and mathematics courses and grades; high school graduating grade point average; Aboriginal status, Canadian born or immigrant to Canada, and disability status.

It must be noted, for some demographic parameters identified in the research outlined above, reliable PSE institutional data may not available, including Aboriginal status (Oldford & Ungerleider, 2010), immigrant generation, and ethnicity. For other parameters, PSE institutional data may be incomplete as students are not required to provide it during the application process.

**Influence and Agency**

This next section reviews the empirical research on influencers and indicators of individual student choice of PSE pathway. As acknowledged by the life course perspective, family members and other close relationships influence individual choice and decision making and individuals exercise agency alongside this influence.

Research conducted by Elder (1998) with inner city students in Philadelphia found that close social relationships were more important than more loosely coupled neighbourhood relationships in supporting successful youth development in several areas, including academic achievement. Canadian research is consistent that children of parents with high levels of education are more likely to participate in PSE themselves, particularly university (Hango & de Broucker, 2007; Shaienks et al., 2008). The family effect also appears to include aspects of *occupational inheritance*, greater for
males than for females and an important contributor to social stratification in Canada (Anisef, Turrittin, & Lin, 1999, p. 43).

Research (Kamanzi et al., 2009) based on data from the first four cycles of the YITS-A cohort examined factors relating to participants’ social and cultural backgrounds (sex, parental occupation and income, first generation status, measures of cultural capital, immigrant status, linguistic group and visible minority status), academic background (average grades in mathematics, languages and science, measures of school engagement, and PISA reading skill level), and geographical location (rural/urban and province of residence). Results supported the concept of occupational inheritance regarding initial PSE pathway however social and cultural characteristics were only weakly related to academic persistence. Secondary school grades had a significant and strong influence on persistence (Kamanzi et al., 2009).

Evidence of family and peer influence is apparent in the Ontario research on PSE planning introduced above. Survey research (King & Warren, 2006) of grade 11 and grade 12 students in 2005-2006 found that significantly fewer students across the GTA planned on attending college instead of university, and fewer students in the GTA had parents who encouraged them to attend college rather than university. Peer opinions of college versus university reflected the proportion of students planning to attend college. The fewer the number of students who planned to attend college, the lower the peer opinions of attending college, with the GTA being one of the areas where peers had the least positive perspective on college as a postsecondary destination (King & Warren, 2006).

As part of the study (King et al., 2009) tracking grade nine students through to PSE enrolment five years later, qualitative interviews were conducted with approximately 200 students aged 18-23 who did not attend PSE directly from high school regarding factors involved in PSE decision-making. King et al. (2009) found that parental education level influenced both student PSE planning and
secondary school achievement. The interview sample was a convenience sample and therefore not necessarily representative of all the students who did not go directly to PSE after high school. Although retrospective and not generalizable, student responses do provide some indication of factors involved in the decision making regarding PSE. Students who identified as university bound were less likely to value a college education and had parents who expected them to go to university. Students who identified as college bound in grade 12 experienced more academic uncertainty regarding their post-graduation plans throughout their secondary education than university bound students. For many, applying to college was a later decision, the result of insufficient grades for university to be an option and/or career uncertainty. The socio-economic neighbourhood of the school also appeared to influence the postsecondary plans of students, with students attending secondary schools in more affluent areas more likely to plan to attend university, and those in less affluent or more diverse areas planning to attend college. From the student perspective, parents and teachers displayed a strong cultural preference for university over college. Students identified that university had higher status and provided greater economic benefits, particularly students in the GTA where parent, student, peer and secondary school institutional support favoured university over college as a PSE destination. Students also noted the influence of their peers on their own PSE aspirations (King et al., 2009). The influence of family, peers, and high school teachers and counselors varies by student pathway (Colleges Ontario, 2008) as shown in Figure 9. Students who enter PSE directly from high school identify higher levels of direct influence from all sources, friends, family, high school guidance counselor and high school teacher.
Longitudinal research by Côté and Levine (1997) with a small sample (initial N=276) of full-time students at one Ontario university, examined student motivational readiness for pursuing PSE based on an empirically tested typology of five motivations: Careerism-Materialism, Personal-Intellectual-Development, Humanitarian, Expectation-Driven, and Default. Questionnaire factor items reflected student attitudes, influences and expectations at entry and again in third year of study. Student motivation was found to be predictive of skills acquisition self-reported during third year, more so than either high school or first year grades which were only predictive of future grades. With the exception of the Career-Materialism motivation which decreased from first to third year, motivation remained stable over time. The Personal-Intellectual-Development motivation demonstrated the most significant relationship with skill acquisition and the Career-Materialism, the second. The Expectation-Driven and Default motivations were poorly related to skill development. The Default motivation as assessed at entry through statements such as I don’t really get anything out of university, but it beats the alternatives, I don’t get anything out of my courses, I am in university
basically because there are few other options, negatively predicted self-motivation and GPA in third year. Although not generalizable, the results of this study suggest students enter PSE with diverse motivations, and student motivation type appears to affect outcomes.

Individuals make life course decisions within a personal context of influence and possibility. The decision to pursue PSE is complex. When, what program, where, with what resources? Young adults are influenced by their family, close relationships and peers on decisions related to PSE pathways, influences which may or may not be congruent with the students’ own interests and desires. These dynamic relationships are situated within a common political, economic, and educational discourse emphasizing the importance of PSE and a prioritization of university over college. Many students, particularly in the GTA, receive the message that college is a less valued option than university. Students who are not able to attend university because of insufficient grades, misaligned course credits, or otherwise a lack of resources, may consider that attending college represents failure or at least a settling for a less desirable path. A delay in the timing of a college application and/or of acceptance of an offer of admission and payment of tuition may indicate the student faces challenges in navigating the transition to college level PSE. This in turn could affect the student’s academic pathway and their persistence along that path.

Research by Lang (2009) on secondary student applications to colleges and universities by students eligible to attend either type of institution supports the results of the qualitative research above (King et al., 2009) on the influence of family and peers on PSE decision making. Lang (2009) showed that student preference for one system over the other was related to socio-economic status and parental educational level. Student academic experience was less relevant. There were also distinct patterns of differences within student groups commonly perceived as homogeneous, such as first generation students. Program choice was more important than institutional reputation for students
applying to and accepting an admission offer from a college. Relative cost was also an important factor.

Some students who enrol in a general business program at college may be choosing the program because they are certain it is the best program to meet their PSE goals. Others may enrol in a general business program because of its lack of specialization and their uncertain personal goals. Students apply to college level programs through OCAS and are able to choose a maximum of 5 different programs and/or colleges. It seems reasonable to expect that the level of certainty regarding program and PSE institution might be reflected in each student’s ranking of the Humber business program in which they subsequently enrol. Persistence and academic pathways for students who rank a Humber general business diploma as their top choice may differ from persistence and pathways for students who rank the same program as choices 2-3 or 4-5.

Postsecondary education institutions do not have data on the individuals, if any, who influenced a student to apply and enrol in a particular program. What they do have is information on how each student ranked the institution and program in his or her application. Institutions also have information on when the student applied and when the student completed the enrolment process by paying tuition or a tuition deferral fee. College and program ranking and timing of application could be seen as indicators of academic certainty regarding PSE plans. Ranking could also be seen as identifying a preference between alternatives and timing of application and enrolment could indicate forward planning, pathway commitment and the availability of resources to both initiate and follow through on PSE plans. This suggests that individual student OCAS rankings for the programs in this research study and each student’s application and enrolment timing could be related to his or her future postsecondary academic pathways and outcomes.
The Institutional Role and Entry into PSE

This section of the review of empirical research examines the role of the PSE institution and how the student must interact with the institution upon entry at the beginning of his or her program, specifically relating to the mathematics and English placement test process and the identification and registration process for students with a disability.

From a life course perspective individuals have agency and make choices within the structure of formal and informal organizations including families, communities and other institutions. These institutions operate to both support individual agency and constrain individual choice and action. Through the use of effective policies and procedures, institutions are able to reduce uncertainty and the risk of poor choices for individuals (Heinz et al., 2009). Seen through this lens, PSE institutions ideally find a balance between flexibility and choice for students and proscribed educational pathways with a higher probability of supporting successful student transition. From the point of view of an individual student however, a successful transition to PSE implies a certain level of socialization, conformity and commitment to the norms of PSE and the PSE institution.

Apart from the general responsibilities all students have when beginning their first term in PSE of registering for class, arranging for parking and/or a locker, buying books and finding their way around campus, some groups of students have additional avenues to navigate. Business diploma students at Humber must complete mathematics and English writing placement tests once they have accepted an offer of admission, and students who require accommodation for a disability must register with Disability Services in order to have access to accommodations. These institutional interactions provide information on some students’ resources and challenges; information which may be predictive of pathways and persistence.
Student scores on the mathematics and English writing placement tests determine whether the student is placed in a curriculum level mathematics and/or English class or a remedial class. Remedial placement is designed as a support to student success as experience has shown that students without the necessary skills placed directly into the curriculum level course will fail. Research (Le & Milburn, 2010) at Humber based on historical data from 2000 to 2008 shows that mathematics placement test scores were significantly and positively related to final mathematics grades in college mathematics courses for business and technology students who had graduated, and also to students’ final program GPA, supporting the use of this placement test as a predictor of traditional measures of PSE student success (Le & Milburn, 2010). However, many students perceive being placed in a remedial class as a barrier to achieving their goals and emotionally discouraging. Both the insufficiency of skills and the emotional impact of remedial placement could be related to a lack of persistence in a program.

First-year college student mathematics achievement has been the focus of Ontario provincial research (Orpwood, Schollen, Leek, Marinelli-Henriques, & Assiri, 2012), beginning with a small pilot project in one college in 2005. For the last three years, all Ontario colleges have participated in the College Mathematics Project designed to analyze college-level achievement relative to secondary school mathematics courses and achievement. The College Mathematics Project 2011 results are based on college and secondary school records of approximately 35,000 first term students who were enrolled in a first term mathematics course in fall 2010. Similar to the previous two years, approximately two-thirds of these students achieved a grade of at least 60% in the college mathematics course. The other students achieved a lower grade or withdrew from the course before the end of the term. Older students generally, and Second Career students more specifically, achieved better grades than younger students. Female students have performed better than male students. Achievement patterns relate to secondary school mathematics pathways. Qualitative analysis of mathematics content at the college level mapped against elementary and secondary
Ontario mathematics curriculum identified that the relevant numeracy skills for success at the college level were generally part of the taught curriculum for grades 6, 7, and 8 rather than for later high school years (Orpwood et al., 2012). This suggests that gaps in the foundational mathematics knowledge and skill levels of students who are placed in a remedial course occur much earlier in their academic pathway than previously understood and therefore grade 12 mathematics course grades may not be the most relevant predictor.

Thiessen (2008) employed the PISA results of reading achievement from 2000 with data from the first three cycles (2000, 2002, and 2004) of the YITS cohort-A to examine factors relating to the PSE pathways of youth who achieved a low reading-achievement score at age 15. Students were classified according to the educational pathways of high school dropout, high school graduate with no PSE and participated in PSE. Students who were still in secondary school at age 19 were classified as a high school dropout. Thirty-seven and a half percent of the students graduated from high school and 35.6% of the students participated in PSE. Factors identified as contributing to low reading-achievement students pursuing PSE were analyzed from the perspective of resilience – measures of barriers, resources, social supports and aspects of resilient behaviour. Results showed that high school dropouts faced the greatest barriers. Students who pursued PSE had fewer and less severe barriers as well as access to greater resources. Dropouts also had the lowest reading scores, while those who pursued PSE had the highest. Factors which enabled students to succeed academically beyond what the reading scores predicted, did so even when the socio-demographic factors related to educational attainment were controlled. Thiessen (2008) concluded that “young people with limited reading achievement can initiate a series of behaviours between the ages of 15 and 17 that enable them to complete high school and even pursue postsecondary education” (p. 54), confirming that individual agency is important factor in the determination of educational trajectories.
Although Humber does not have access to individual student PISA reading achievement scores, it is suggested that high school English grades would reflect to some extent each student’s language ability, including reading, leading to the question how high school English grades and/or English writing placement test scores at college entry relate to student PSE academic pathways and persistence.

As previously reviewed, students with disabilities and other special needs face greater challenges at the secondary level and are less likely to pursue PSE. Those that do are more likely to pursue PSE at a college than at a university. In her literature and environmental scan of mental health in PSE, MacKean (2011) found that many PSE students experience mental health issues and more students with chronic issues are participating in PSE. Students have reported factors such as stress, anxiety, and difficulties with sleep which interfere with academic performance. Medications prescribed to manage mental and physical challenges can have side effects which also negatively affect concentration, short term memory and therefore academic performance.

Patterson & Kline (2008) provide information on significant health challenges within PSE institutions in Canada and on the impact of health issues on student learning. Data for this study were collected through eleven college and university focus groups – two of which were in Ontario, 20 telephone surveys of administrators in the Student Services areas of those same institutions – 16 of which were in Ontario, and 32 responses to an email survey of members of the Canadian Association of College and University Student Services. Results confirm how interrelated health is with other aspects of students’ lives. Health issues have a “…‘domino effect’…[a]vicious cycle of academic, personal, financial, lifestyle and health concerns sometimes resulting in dropping out or reductions in academic performance” (Patterson & Kline, 2008, p. 5). The most frequent concern identified by both students and student services administrators was mental health including depression together with fatigue,
stress and weight/diet/nutrition. Although the sample size in this study was quite small, the findings are supported by more recent research in this area.

Holmes, Silverstri, & Kostakos (2011) conducted research into mental health concerns within the Ontario community college population. Survey results based on students who accessed counselling and student support services during the 2009-2010 academic year at fifteen Ontario colleges, showed that 60.9% of students who participated in the survey reported one or more mental health diagnoses and 67.7% reported experiencing academic challenges, many of which appeared related to the reported mental health concerns.

Not all students who have difficulty with anxiety, depression, or other mental health challenges will access counselling on campus and not all who access counselling will go on to be registered as a student with a disability. Administrative data based on students registered with Disability Services therefore underreport the number of students affected by health or learning related challenges. Many students may be reluctant to disclose their personal situation, be reluctant to use accommodations, be unaware of supports available and/or not know how to access support. Students must be their own advocates in the postsecondary environment and for many this complicates the transition to PSE.

The process for accessing academic accommodations at the postsecondary level is different from the process at the secondary level. Many students in high school are provided with additional support based on evidence of their academic challenges rather than on a psycho-educational assessment and identification of a specific learning or other disability. At the postsecondary level, access to accommodations is predicated on a documented diagnosis. Students must go to the appropriate student services office, make an appointment and provide the required documentation. Students may have to arrange and pay for a psycho-educational assessment. They may lack financial resources and the assessment process takes time. Even if a student begins the process in
late August, accommodations may not be in place until mid or late-term. Registering for support and accommodations must be done each term. Due to an imbalance between the supply of disability support services and the demand for services at the beginning of each term, many students must wait for their paperwork to be finalized which causes delays in receiving support. Participating in class and/or assessments without appropriate accommodations may well affect academic pathways and persistence.

This body of research suggests that English and mathematics placement test results and course placement, and being registered with disability services for one or more terms could be predictors of PSE persistence and differentiated academic pathways and outcomes for individual students.

Postsecondary Education Pathways and Persistence

As noted above, persistence in PSE in Canada has not been a research focus to the same extent that access and participation in PSE has. It has commonly been assumed that the student groups with lower access to or participation in PSE are also those groups which face difficulty persisting and completing, with persistence and completion both measured in the traditional manner. In their state of the knowledge review of access, persistence and barriers in PSE for HEQCO, EPI (2008) stated, “We do not know specifically about the completion status of all groups, but the best guess is that the same groups which are known to have systematic difficulties in accessing PSE also have systematic difficulties in completing it” (p. 19). The most recent research from YITS discussed in more detail below, refutes this assumption and provides support for a focus on individual student pathways and persistence (Finnie, Childs, & Qui, 2012, p.49).

Postsecondary education longitudinal research shows that just as students take diverse pathways through secondary school and into PSE, they also follow diverse pathways within PSE (Andres, 2013; Lavin, 2011) and have varied reasons for non-completion (Martell, 2011). Not surprising, the
length of the research period has a marked effect on findings, with longer tracking uncovering higher completion rates (Andres, 2013).

Research utilizing data from YITs has identified different patterns of participation and completion between college and university systems, including higher dropout rates for college students (Finnie & Qiu, 2008a, 2008b). Female students demonstrate longer term persistence than male students (Ma & Frempong, 2008; Martinello, 2008; Shaienks & Gluszynski, 2007; Shaienks et al, 2008) at both levels (Finnie & Qiu, 2008b). Higher high school grades (Shaienks et al., 2008) and postsecondary grades are strongly related to persistence (Finnie & Qui, 2008b) although a significant minority of students who drop out have high school and/or postsecondary grades over 80% (Shaienks & Gluszynski, 2007). Younger students demonstrate greater persistence than older students (Finnie & Qui, 2008b) and non-Canadian born students have higher dropout rates from college than Canadian born students (Shaienks et al., 2008). No increased likelihood of leaving prior to completion for students who were members of a visible minority or for first generation students has been identified (Shaienks & Gluszynski, 2007); however, parental education level appears related to an increased likelihood to return to PSE after having left (Martinello, 2008). Lower persistence also appears related to coming from a rural area (Shaienks & Gluszynski, 2007), having limited PSE goals, having dropped out of high school at some point, having experienced drug use in high school, having achieved a GPA less than 60% in first year of PSE, having participated in limited social and community opportunities including networking and volunteering, having limited financial resources or supports, and having married during the PSE period (Ma & Frempong, 2008).

Survey research (Sattler, Academica Group Inc., 2010) on pathways to PSE and the labour market of Ontario college and university applicants found no significant difference in persistence for Aboriginal students, first generation students or for non-direct entry students compared to students who were not members of these groups. Students who left PSE before completing a program were
more likely to be male, have a disability, or have lower secondary school grades. Graduates were also more likely to have received an offer to the program they ranked as their first choice in their PSE application. In a separate study, Fisher and Engemann (2009) found more first year students who were unsuccessful in an academic upgrading course did not return the following year.

The research most specific to academic persistence of Ontario college students is that of Finnie, Childs, and Qui (2010) and Finnie, Childs, and Qui (2012), based on the YITs datasets. Finnie et al. (2010) found Ontario college students displayed varied paths through PSE. Rates of switching programs and rates of leaving were higher in first year, declining thereafter. The most common reasons given by students for switching or leaving was didn’t like it/not for me, to change schools or programs, wanted to work, and marks too low. More than 40% of the students who left returned within 3 years. The overall PSE graduation rate including students who switched programs and students who left and returned was 70.6% within 5 years, with another 6.3% still enrolled (Finnie et al., 2010). The findings of the regression analysis estimating the probability of switching institutions or leaving PSE in any particular year with associated variables must be interpreted with caution as sample sizes were limited. Unemployment rate, sex, and year of program had no statistically significant impact. Entering a PSE program at or older than age 21 was associated with a higher probability of leaving however, this was not significant at the individual level. Immigrant and visible minority students had a lower probability of leaving. Family background was a significant factor. Higher high school grades appeared to be a predictor of a lower risk of leaving however PSE grades were a better one; PSE grades were strongly related to PSE persistence. Finnie et al. (2010) concluded,

a substantial proportion of individuals follow what could be considered “non-traditional pathways”, which includes switching programs, taking breaks, and otherwise moving in and out of PSE as they work their way through their studies…Persistence rates are found to be much higher when viewed from this broader perspective. (p. 29)
The research of Finnie et al. (2012) focusses on Ontario college students who were members of underrepresented and minority groups including first generation, Aboriginal, with disabilities, rural, low-income, from single parent families, and 1st and 2nd generation immigrant students. Many of the students were members of more than one underrepresented group. The dropout rate was highest in first year. The most common reason given by students for leaving their first program was didn’t like it/not for me followed by health, personal or other reason and to change schools or programs. At the three-year mark, 65.8% of students who first entered into a college program in Ontario had graduated and 16.6% were still enrolled for an overall college persistence rate of 82.4%. At the national level, with simple two-way analysis, three groups experienced lower persistence rates in college – students with disabilities, students from low-income households and students from single-parent families. When other factors were considered, including membership in other groups and high school and postsecondary grades, persistence rates for students in these groups did not differ significantly from those of other students (Finnie et al., 2012).

Finnie et al. (2012) conclude student persistence must be approached at the level of the individual student.

The findings suggest, in particular, that targeting identifiable groups for interventions aimed at PSE retention may not be as effective as other potential strategies for identifying those students at greatest risk of dropping out…In particular, favouring one or two particular types of students (e.g., first generation PSE students) would appear to amount to a relatively blunt policy tool, since such a strategy will, in most cases, be targeted at students with persistence rates that are only marginally different from others (if at all) and miss others who are at risk. A better strategy would likely be to look at other factors at the same time, including membership in other groups or, more simply and probably more effectively, to target interventions at students according to their academic records, going back to high school and within PSE. Such a strategy may not only be more effective in identifying students at risk of
not completing their PSE studies, but may also be more attractive from a meritocratic perspective by treating students as individuals rather than as members of groups. Using such an approach, students would not be treated differently with respect to their family backgrounds, but would instead have assistance provided depending on their past and current academic records and related profiles. (p. 49)

Summary

Canadian longitudinal research on the student experience of transitioning to PSE and through to the labour force shows that PSE academic pathway and persistence appears to differ somewhat by student group. However, once other factors are controlled, significant differences are found within student groups. High school grades and early postsecondary grades may be among the best predictors of academic success however, they are not perfect. Not all students with strong grades persist and not all students with low grades leave. For timely identification of students on differentiated pathways, the most useful information would come as early as possible in the institution-student relationship and prior to the disintegration of a previously successful pathway. From the perspective of individual students, the critical juncture may occur at different times in the student-institution interaction.

Existing conceptualizations of student persistence in PSE are focussed at the student group level and on student demographic characteristics perceived as placing some student groups more at risk of non-completion. Longitudinal research in Canada, including those studies which disaggregate Ontario college student results, clearly demonstrates that academic pathways and persistence vary within student groups. Identification of institutionally available, student behavioural indices predictive of differentiated academic pathways and persistence would permit individualized support of student success, an approach supported by Finnie et al. (2012),
The use of the institutional data held by colleges and universities could be particularly helpful in this regard, especially as the most effective interventions could be targeted based on such information. The effects of any such intervention would also best be evaluated at the same level. Persistence essentially “happens” at given institutions, and so it makes sense that institutions should be the focus of further research, policy experiments and assessments of what works. (p.50)

The empirical research above reviewed from a life course perspective highlights certain characteristics and markers of the student transition from secondary school through entry into PSE which may be related to individual persistence and academic outcomes and pathways. The research on secondary school trajectories and the transition to PSE suggests certain student and college entry characteristics as relevant predictors of future academic pathways and outcomes including direct or non-direct from high school applicant; sex; ESL status; urban or rural high school community; Academic or Applied level grade 9 and 10 English and mathematics courses and grades; university or college preparation grade 11 and 12 English and mathematics courses and grades; high school graduating grade point average; Aboriginal status, Canadian born or immigrant to Canada, and disability status.

Research on influencers and indicators of student choice of pathway suggest student ranking of choice of program through OCAS and information on the timing of student application and enrolment may also be relevant predictors of future PSE academic pathways and outcomes. Research on the role of the institution at the time of entry into first term suggests mathematics and English placement and placement test results, and student registration with Disability Services may be relevant predictors for future academic pathways and outcomes at the level of the individual student.
Chapter Three: Research Design

Overview

In this chapter I detail the research design of this study. I first describe the institutional datasets including independent variables and their limitations, and the dependent variables. The discussion following reviews the research design, the plan of data analysis, an overview of sequence analysis with optimal matching and cluster analysis, a review of the literature supporting the analytical methods, and the limitations of the analytical methods. I conclude with a summary of the methodology.

The Datasets

This study relies on historical institutional administrative data. Using administrative data permits the inclusion of all individual students in an entering year cohort and therefore provides a complete dataset rather than a sample. The use of administrative data also avoids the major limitations of survey data – response bias and selection bias.

The data were provided by the department of Institutional Research and Planning at Humber. Seven anonymized files with information relating to all individual students enrolled in the first semester of the Business Management, Business Marketing, Business Administration and Business Administration Co-op diploma programs at North and Lakeshore campuses in fall 2006 (N = 797) were provided to the researcher. Identifying student information had been masked and each individual student file coded by an identification number from 1 to 797.

The files consisted of 1) Demographic information provided by students when they applied to Humber through the Ontario Colleges Application Service (OCAS), a web portal for applications to programs offered by the Ontario community colleges; 2) Mathematics placement test scores and
English writing and mathematics course placement data for fall 2006; 3) High school transcript data, where available; 4) Disability Services registration data for fall 2006-fall 2012 inclusive; 5) Humber enrolment and completion data by individual course and term for fall 2006 to fall 2012 inclusive; 6) Humber academic progression data from fall 2006-fall 2012 inclusive; and 7) Humber graduation data for fall 2006-fall 2012 inclusive. As described below, relevant data from each of the files were cleaned, recoded as necessary into a format supported by R, the statistical analysis software used in this study (R Core Team, 2012), and merged into one Excel comma separated value file. All binary categorical variables were coded yes, no in the comma separated value file.

Of the 797 individual student cases, 7 were removed from the final dataset. The cohort student list was run as of day 10 of the fall 2006 term, the final day that courses could be added to a full-time student timetable and therefore the last day a student could be registered and enrolled for the term. Although these seven cases were included in the files as part of the cohort by Institutional Research and Planning, there were no records of enrolment in any courses for these students during the research period. The final sample comprised 790 cases.

**Independent Variables and Their Limitations**

Independent variables include student demographic variables, academic variables related to prior academic trajectories, and college entry variables from the application-enrolment process for fall 2006 program entry.

**Student demographic variables.** Student demographic variables relate to information provided by each student on his or her college application through OCAS. This information has not been subjected to independent verification.

*Age in fall 2006* was provided by Institutional Research and Planning based on student date of birth.
Sex was an original variable in the dataset as provided by Institutional Research, recoded in the final dataset as a binomial variable Male – yes, Female – no.

Country of Birth as provided in the original file was initially recoded on a regional basis: Africa, Asia, Canada, Caribbean, Central and South America, Eastern Europe, Middle East, South Asia, Southeast Asia, Western Europe and Unknown following the institutional practice for internal reporting purposes. However, the size of the resulting subgroups was too small to be used in analysis. In the final dataset Country of Birth is coded as a binomial variable as Birthplace-Canada – yes, Other – no.

International Student Status was an original variable in the dataset, and is coded in the final dataset as a binomial variable, International – yes, Domestic – no. As there were few international students (n=32) relative to the size of the cohort, this variable was unable to be used in analysis.

High School Postal Code was provided in the original file and was not used in the final dataset to identify student location as rural or urban. The postal code on its own without details on duration of attendance was considered to be insufficient to support analysis or conclusions.

Prior academic variables. Student academic variables relate to high school transcript information submitted by secondary schools through OCAS as part of each student's application. These are considered key variables, and it was disappointing to discover that the college had electronic records of grade 9 and grade 12 English and mathematics course type and course grades for only a small subset of students, approximately 14-15% of the cohort, limiting the conclusions which can be drawn from analysis. Two explanations were provided for the missing data. First, many students apply to the college as mature students and therefore may not submit high school grades. For this group of students, admission is not achievement based. Second, in 2006, the application process was migrating from a manual to an online process, and many applications were
still paper-based. High school transcripts for the paper based applications would have been reviewed as necessary for an offer of admission to be made, however, the details of courses and final grades would not have been manually entered into the system due to resource constraints. Given that the programs the study is centred on are access programs, offers of admission are not grade based or ranked. If students have graduated from high school and have completed the requisite number and type of courses (high school minimum passing grade is 50%), they will receive an offer of admission unless the program is full for that intake. For the programs which are the subject of the study this rarely occurs and when it does it occurs close to the start date of the term.

Where provided, high school English and mathematics courses were identified in the file by course code and name, for example MAP4C1, College and Apprenticeship Mathematics. The codes were checked against a list provided by Institutional Research and by internet search of Ministry of Education and/or Ontario school board documents, as necessary, to differentiate grade 9 (level 1) applied or academic and grade 12 (level 4) college or university courses. All grade 9 courses identified as other than academic are coded as applied. All grade 12 courses with the identifier "U" in the code to signify a university preparatory level course are coded university; all others are coded college. For students for whom there is no information on high school courses or grades, the coding is N/A for not applicable.

*Grade 9 Mathematics Course* is coded as applied, academic, or N/A.

*Grade 9 Mathematics Final Grade* was an original variable in the dataset as provided by Institutional Research and is a continuous variable with a maximum value of 100. Where there is no grade, it is coded as N/A.

*Grade 9 English Course* is coded as applied, academic or N/A.
Grade 9 English Final Grade was an original variable in the dataset as provided by Institutional Research and is a continuous variable with a maximum value of 100. Where there is no grade, it is coded as N/A.

Grade 12 Mathematics Course is coded as college, university or N/A.

Grade 12 Mathematics Final Grade was an original variable in the dataset as provided by Institutional Research and is a continuous variable with a maximum value of 100. Where there is no grade, it is coded as N/A.

Grade 12 English Course is coded as college, university, or N/A.

Grade 12 English Course Final Grade was an original variable in the dataset as provided by Institutional Research and is a continuous variable with a maximum value of 100. Where there is no grade, it is coded as N/A.

Final Year High School GPA was estimated from the original data file by calculating the simple average of 6 C, U, or M courses identified as levels 4 or 3 in the course code (signifying grades 12 and 11), and including mathematics and English courses where available.

**College entry variables.** College entry variables relate to the application-admission-enrolment process between the student and the college during the period from time of application to the beginning of the first term in fall 2006. These variables are obtained from OCAS data and Humber's historical administrative files. The application window for the fall 2006 semester opened in fall 2005. The equal consideration date, at the beginning of February each year, is the date that all applications received by the college at that time are given equal consideration for an offer of admission. Some in-demand programs are full and closed to additional applications in the spring each year. As the business diploma programs are open access and general, applications are
received and processed until the programs are full or until the end of the first week of classes. It is not uncommon for applicants to these programs to be accepted into the fall intake between August and early September. As with all administrative data, there may be errors; however, there is no reason to suspect that the errors are systematically related to the questions of interest or any of the explanatory variables.

**OCAS Choice** is an original ordinal variable in the dataset as provided by Institutional Research with a range of 1-6. The variable is also recoded as three yes-no binomial variables, OCAS Choice 1 and 6, OCAS Choice 2-3 and OCAS Choice 4-5. When students apply through OCAS, each student is permitted to make five program/college choices numbered 1-5. Choice 6 is used internally by Humber to denote a student who applied directly to the college. To the extent that the choices made by students reflect a hierarchy of preference, OCAS Choice 1 can be interpreted as a student's top priority as can a college program a student applied to directly. OCAS Choice 1 is grouped with Choice 6 to reflect this. Choices 2 and 3, and 4 and 5 are grouped together respectively. Choice 2 is arguably, not substantively different from 3, however it is more so from the two lowest rankings of 4 and 5. OCAS Choice permits the exploration of relationships between student choice and academic achievement and pathway.

**Entry Status** was an original variable in the files as provided by Institutional Research, identified as current high school – an applicant enrolled in high school at the time of application, or non-current high school – an applicant who had previously graduated from high school and/or who is applying as a mature student. In reviewing the dataset, the categorization did not appear to fit the information on student age, and clarification was requested from Institutional Research and Planning. After examining the files, it was suggested to me that this field could not be relied upon for accuracy, and therefore it has not been coded to form part of the final dataset.
Applied by July 1, 2006 is a binomial yes-no variable coded based on individual student application and enrolment status as at July 1, 2006 in the original files. This variable and the following one permit the exploration of relationships between date of application and academic achievement and pathway. Arguably, an earlier application date may indicate a student who is more certain and directed towards a particular college, program of study or career path and/or a student who is not facing challenges which might negatively affect his or her ability to pursue an identified goal.

Applied and Enrolled by September 1, 2006 is a binomial yes-no variable coded based on individual student application and enrolment status as at September 1, 2006 in the original files.

Entry Program is an original categorical variable in the dataset as provided by Institutional Research, recoded as four yes-no binomial variables for each of Business Management (BM), Marketing Management (MM), Business Administration (BAR), and Business Administration Co-op (BAC).

Entry Campus is an original binomial variable in the dataset as provided by Institutional Research recoded as Lakeshore Campus – yes, North campus – No. The two campuses are situated in different parts of west Toronto and are distinguishable by structure and culture. Faculty observation is that student demographics are different across the two campuses. This variable is included to explore whether the campus of entry is related to different academic achievement outcomes or pathways.

English Course Placement is an original categorical variable in the dataset as provided by Institutional Research. The English course placement for first semester is determined by a short written essay double-blind graded by English faculty members. Students who demonstrate skills at the program entry level are placed in either COMM 200 or, for those identifiable as having English as not their first language (ESL), ESL.200. Students who demonstrate weaker skills are placed in a remedial level course, COMM 100 or, if they are identifiable as ESL, ESL.150. Students who
demonstrate above program level skills are given an exemption for COMM 200 and are placed in the second semester course, COMM 300.

*Arithmetic Score* is an original continuous variable in the dataset as provided by Institutional Research. The maximum value is 120 and the student is expected to score at least 80/120 to be placed in the program level mathematics course in first semester.

*Algebra Score* is an original continuous variable in the dataset as provided by Institutional Research. The maximum value is 120 and the student is expected to score at least 60/120 to be placed in the program level mathematics course in first semester.

*Total Mathematics Score* is an original continuous variable in the dataset as provided by Institutional Research. Total mathematics score is the sum of the student's arithmetic score and algebra score, and determines the mathematics course placement for first semester. If the total mathematics score is greater than, or equal to, 140 the student is placed in the program level mathematics course BMAT 220. If the total mathematics score is less than 140, the student is placed in the remedial mathematics course BMAT 110.

*Mathematics Course Placement* is an original binomial variable in the dataset as provided by Institutional Research, BMAT 110 or BMAT 220, recoded as Remedial Mathematics yes – no.

*Transfer Credit* is a derived variable from the data on courses enrolled in first semester. The binomial variable is coded *yes* for students who had one or more exemptions for program courses and *no* for students with no exemptions for program courses. Exemptions are normally granted when a student has passed an equivalent course at another PSE institution, or for COMM 200, based on English placement test results as described above.
Disability Status is an original variable in the dataset as provided by Institutional Research and has been coded as a binomial yes-no. Unfortunately, the number of cohort students who registered with Disability Services for at least one term during the research period was too small (n = 31) to be used in analysis, and was therefore disregarded.

Dependent Variables

There are two categories of dependent variables, academic outcomes, as traditionally-defined and as research-defined, and individual and typical or representative student academic pathways.

**Academic outcomes.** Academic outcomes include the traditional outcome of graduation rate and the research-defined outcomes of graduate with a diploma or higher credential (2 year diploma, 3 year diploma, bachelor degree or postgraduate certificate), total courses enrolled (all courses enrolled in by individual student during the research period, a measure of persistence), total courses passed (all courses passed by individual student during the research period, a measure of academic achievement), and course completion rate (the ratio of total courses enrolled by total courses passed, a measure of alignment between student intention and achievement).

**Individual and typical student academic pathways.** Individual student academic pathways are derived through the application of the technique of sequence analysis, described in detail below, with individual student enrolment and achievement statuses as described in this section. Typical student pathways representative of a group of sequences are then determined with optimal matching and cluster analysis described below in the data analysis section.

Individual student academic pathways are developed as sequences of enrolment and achievement states. It is common in the literature to use states identified monthly or annually to create each sequence. In this study, annual categorization would obscure important information. On the other hand, monthly categorization would significantly increase the complexity of each sequence without
adding to our understanding. The business diploma programs operate on an academic term basis; each term is fifteen weeks in length, with three terms each year, fall, winter and summer. Student enrolment and achievement status are identified by term as this unit of time best fits the pathways of interest and provides the appropriate balance between sufficient clarity and relevant detail.

College course enrolment data permit the identification of beginning-of-term enrolment status and end-of-term academic achievement on a term-by-term basis for each individual student based on the number of courses enrolled and the number of courses passed. College graduation data also permit the identification of timing of graduation for all students who completed a diploma or higher credential. Based on this information, for each term of the research period, fall 2006-fall 2012, students are classified by one of eight enrolment/achievement states as shown in the Sequence Encoding Scheme in Table 2. Each student's enrolment state is coded as full-time (F), enrolled in at least 4 courses at the beginning of the term; part-time (P), enrolled in fewer than 4 courses; not enrolled (N), not enrolled in any classes; withdrawn (WD), the student was required to withdraw from the program due to low academic standing; or enrolled while withdrawn (WE), the student was withdrawn from the program for academic reasons and enrolled in one or more courses through Continuing Education. For each of the full-time (F) and part-time (P) enrolment states, achievement is coded either high (H) or low (L) based on the number of courses passed relative to the number of courses enrolled in. The eighth possible state is graduate (G) for the term the student completed a program and graduated with a two-year diploma or higher credential.
Table 2: Sequence Encoding Scheme

<table>
<thead>
<tr>
<th>Variable</th>
<th>Category</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enrolment</td>
<td>Achievement</td>
<td></td>
</tr>
<tr>
<td>≥ 4 courses</td>
<td>passed ≥ 4 courses</td>
<td>FH</td>
</tr>
<tr>
<td>≥ 4 courses</td>
<td>passed ≤ 3 courses</td>
<td>FL</td>
</tr>
<tr>
<td>1 - 3 courses</td>
<td>passed all courses</td>
<td>PH</td>
</tr>
<tr>
<td>1 - 3 courses</td>
<td>did not pass all courses</td>
<td>PL</td>
</tr>
<tr>
<td>no courses</td>
<td>not enrolled</td>
<td>N</td>
</tr>
<tr>
<td>no courses while withdrawn</td>
<td>withdrawn</td>
<td>WD</td>
</tr>
<tr>
<td>any courses while withdrawn</td>
<td>enrolled while withdrawn</td>
<td>WE</td>
</tr>
<tr>
<td>graduated with a diploma or higher credential</td>
<td>Graduate</td>
<td>G</td>
</tr>
</tbody>
</table>

Research Design

This is a longitudinal study with panel data, the fall 2006 entering student cohort in four general business diploma programs at Humber: Business Management – a two-year program at North and Lakeshore campuses, Business Marketing – a two-year program at North campus, Business Administration – a three-year advanced diploma program at North and Lakeshore campuses, and Business Administration Co-op – a three-year advanced diploma program at Lakeshore campus. These programs have been selected because they share a common curriculum platform for the first two terms. With limited admissions criteria, these programs are considered open access and provide many students who did not achieve high grades in high school or complete a high school diploma with an opportunity to participate in PSE, including pathways to degree level study. These programs are also very flexible; students have many options regarding study mode including full-time and part-time enrolment; daytime, evening and online courses are offered three terms each year.

The 2006 entering cohort has been selected as it is the earliest student cohort for which more complete institutional administrative data are available from the current data management systems within the college. Although longitudinal mapping for a longer period of time would be desirable, the
research is constrained by the availability of the data in a format which is accessible and more readily usable.

Longitudinal research involves the collection and analysis of "time-ordered data" (Campbell, 2001, p. 1685) and therefore is particularly suited for research mapping student academic participation and achievement over an extended period. Mapping individual student enrolment status for three terms per year in each of six plus years (19 data periods per student), together with academic achievement outcomes for enrolled terms, permits a holistic understanding of individual student pathways and persistence over time. Longitudinal research permits the establishment of "temporal priority", important to any discussion of association, and also supports identification of patterns at the individual level which are otherwise obscured at a macro level (Campbell, 2001, p. 1685).

There are two limitations to a longitudinal study with the proposed dataset. One is that pathways are dynamic and therefore enrolment and achievement statuses along the pathways and academic outcomes are the result of both initial starting point and ongoing experiences. A second limitation is that all students who do not return to the college in one or more subsequent terms are considered as qualitatively similar although the reasons for not returning are likely diverse. Based on the data available it is not possible to distinguish a student who continues his or her education at another PSE institution from one who leaves to take a job or leaves for health or family reasons. The results of the study are limited to the students in the 2006 entering cohort of the four general business diploma programs and are not generalizable to other student groups at Humber or at any other PSE institution.

Longitudinal research has been referred to as the "Hubble telescope" of social sciences, "[allowing] the observing researcher to look back in time and record the antecedents of current events and transitions" (Butz & Torrey, 2006, p.1898). Life course research examines the institutional and policy influences on the "social structuring" (Mayer, 2009, p. 423) of individual lives, and whether and how
early life factors affect trajectories later in life (Mayer, 2009), a relationship described “as a time-dependent, dynamic linkage between social structure, institutions, and individual action” (Heinz et al., 2009, p. 15). Elder & Giele (2009b), in their overview of the history of the life course framework, credits the emergence of contextual research questions and the growth of longitudinal research in the 1960s as “necessary but clearly not sufficient as catalysts for the development of the life course models in the 1970’s” (p. 3). Research informed by a life course perspective therefore requires longitudinal research.

The research design has been reviewed by the Behavioural Research Ethics Board at University of British Columbia. Details are provided in the Preface. The research design has also been reviewed by the Chair of Humber’s Research Ethics Board, Dr. Patricia Morgan, who determined that Humber College Research Ethics Board approval was not necessary based on the methodology of data collection outlined above whereby only masked data would be provided to the researcher. Analysis is performed and reported on an aggregate basis. No individual students are identified. As a consequence, there is no risk to individual students as a result of this study.

**Plan of Data Analysis**

The purpose of this research is to map student academic outcomes, academic pathways, and variations in pathways as related to student demographic characteristics, prior academic trajectory indices, and college entry indices. Logistic regression is used to analyze the relationship between graduate with a diploma or higher credential with these variables. Linear regression is used to analyze the relationship between total courses enrolled, total courses passed, and course completion rate with these variables, according to the following technique. First the complete model is assessed, including interaction effects between variables. Insignificant variables are dropped from the model and the regression is rerun using the backward stepwise technique employing the `step()` function in R (Crawley, 2013). Further deletions are made manually with analysis of variance of
each resulting reduced model, until all remaining variables are significant to the level of at least 5.0%. The most parsimonious models are described in Chapter 4.

Mapping pathways involves identifying academic events for individual students, and therefore the duration, sequencing and spacing of events (Billari, 2001; Settersten & Mayer, 1997). Three quantitative data analysis techniques, descriptive and analytic, are used: sequence analysis with optimal matching and cluster analysis, logistic regression, and discrepancy based analysis of sequences. Sequence analysis is used to map individual student academic pathways and persistence in PSE. Sequence analysis with optimal matching and cluster analysis is used to identify typical sequence pathways – patterns of achievement and persistence. Regression is utilized to analyze relationships between student demographic, prior academic and college entry characteristics, and typical academic pathways, as represented by the clusters. The quality of the clusters is evaluated and discrepancy analysis is used to analyze relationships between student demographic, prior academic and college entry characteristics, and the dissimilarities between individual student academic pathways.

All analyses were conducted using R (R Core Team, 2012). R is open source statistical and computing software with superior graphing capabilities and is available online at the CRAN (2013). Different packages have been developed to perform different types of statistical analysis in R. Sequence analysis alone and with logistic regression relies on the TraMineR package (Gabadinho, Ritschard, Müller, & Studer, 2011; Gabadinho, Ritschard, Studer, & Müller, 2009), cluster analysis and measures of cluster quality rely on the WeightedCluster package (Studer, 2013), and discrepancy analysis relies on the TraMineRextras package (Ritschard, Studer, Buergin, Gabadinho Muller, & Rousset, 2013).
Sequence Analysis with Optimal Matching and Cluster Analysis

The primary student outcomes of interest, student academic pathways, are not individual events or states; rather they are holistic sequences of interrelated experiences across time (Fuller & Martin, 2012, p. 139). Holistic methods of analyzing transitions in life course research, which take the entire trajectory as the unit of interest, include latent class analysis and sequence analysis. These two techniques derive from different statistical perspectives. Sequence analysis is an exploratory data mining technique with no assumptions about the underlying relationship between variables. Latent class analysis is a "probabilistic modelling" technique where latent aspects explain any correlation of variables (Barban, 2010, p. 17; Barban & Billari, 2012, p. 766). In their comparison of the results of these two approaches on the classification of life course trajectories with both real and simulated data, Barban (2010) and Barban & Billari (2012) conclude that the life trajectory classifications are similar with the two techniques. Sequence analysis appears to provide better results when sequencing and timing result in within-group differences, as with the current study, whereas latent class analysis does so where differences are random or the data are censored and sequences are of unequal lengths.

Sequence analysis was introduced in the social sciences by Abbott (1983, 1990, 1995), who adapted sequencing methods used in DNA sequencing. Questions about sequences can be categorized as (1) Does one or more typical sequences exist; (2) Why do one or more patterns exist; and (3) What consequences are there from these patterns (Abbott, 1990)? Sequence data consist of "an ordered listing of items" (MacIndoe & Abbott, 2004, 2009, p. 387). The unit of analysis in sequence analysis is a sequence of individual data points input as an "ordered array" (MacIndoe & Abbott, 2004, 2009, p. 387).

In the current study, sequence analysis is used to map and analyze student academic pathways through a process of identifying and categorizing student enrolment and achievement states in each
academic term from fall 2006 to fall 2012. Successive states derive meaning related to prior states and the passage of time (Gabadinho et al., 2011). Sets of sequences are visually displayed to highlight underlying patterns, for example sorted by beginning or ending state, or by the most frequent sequences. Longitudinal characteristics such as time in each state are examined, as are aggregated characteristics such as transition rates.

Sequence analysis is used with optimal matching, a method of aligning sequences based on degree of (dis)similarity. Sequences are then analyzed to identify whether there are patterns of sequences through agglomerative hierarchical clustering. Next, identified sequence typologies are used as dependent variables through binary logistic regression to analyze whether the typical sequences are associated with student demographic, prior academic, or college entry characteristics. For a detailed description of sequence analysis with optimal matching and cluster analysis in R, see Gabadinho et al., (2011). The final step is to analyze the quality of the typical sequences and employ discrepancy analysis with individual sequences using R to assess whether differences between individual sequences are associated with student demographic, prior academic, or college entry variables following the techniques described by Studer, Ritschard, Gabadinho, and Müller (2011).

The first step in this process is to describe and visually display the individual student academic sequences. The sequence encoding scheme detailed above identifies eight possible states for any one term. Table 3 below provides the sequence colour coding and Figure 10 displays sample sequences for three individual students for the 19 research terms.
Table 3: Sequence Colour Coding

<table>
<thead>
<tr>
<th>Colour</th>
<th>Short Label</th>
<th>Long Label</th>
</tr>
</thead>
<tbody>
<tr>
<td>FH</td>
<td>Full-time high achievement</td>
<td></td>
</tr>
<tr>
<td>FL</td>
<td>Full-time low achievement</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>Graduated</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>Not enrolled</td>
<td></td>
</tr>
<tr>
<td>PH</td>
<td>Part-time high achievement</td>
<td></td>
</tr>
<tr>
<td>PL</td>
<td>Part-time low achievement</td>
<td></td>
</tr>
<tr>
<td>WD</td>
<td>Withdrawn for academic reasons</td>
<td></td>
</tr>
<tr>
<td>WE</td>
<td>Enrolled while withdrawn</td>
<td></td>
</tr>
</tbody>
</table>

Figure 10: Sample Sequences

All three students in the sample sequences were enrolled full-time in fall 2006. Student A followed a traditional pathway of fall and winter enrolment for three consecutive years, not enrolled in the summer terms. Student A successfully completed at least four courses in each term, graduated with a diploma or higher credential after six terms at the end of winter 2009, and did not return in a subsequent term during the research period.

Student B's pathway began in a similar pattern to student A and then diverged. Student B passed at least four courses during each of fall 2006 and winter 2007, and did not enrol in classes the summer of 2007. Then, as a full-time student, student B passed fewer than four courses in fall 2007 and at least four courses in winter 2008. Student B did not enrol again until summer 2009 when, as a part-time student, s/he did not pass all the courses enrolled in. Student B did not return in a subsequent
term and did not graduate with a diploma or higher credential from Humber during the research period.

Student C has a more varied pathway. Fall 2006 and winter 2007 student C enrolled as a full-time student, passed fewer than four courses each term, and was required to withdraw for academic reasons for two terms during which s/he did not enrol in Continuing Education courses. Student C returned to full-time enrolment in winter 2008, successfully passed at least 4 courses, then enrolled part-time in summer 2008 and passed all enrolled courses. After three terms not enrolled, student C returned full-time in fall 2009 and winter 2010, passing at least four courses in both terms. Student C graduated with a diploma or higher credential in summer 2010, did not enrol for fall 2010 and returned again in winter 2011 as a full-time student. At the end of four more terms of diverse enrolment and achievement, student C graduated with a second diploma or higher credential, having persisted in PSE for almost six years.

With 8 states and a sequence length of 19, it is possible to create $8^{19}$ different sequences. Optimal matching, a process to align similar sequences, is used to analyze the sequences of states (Martin, Schoon, & Ross, 2008), and cluster analysis is used to reduce the complexity and variation in the sequences while maintaining the essential nature of the data as sequential (Brzinsky-Fay, Kohler, & Luniak, 2006; Fuller, 2011; Fuller & Martin, 2012; MacIndoe & Abbott, 2004, 2009).

How costs are assigned to the transformation of one sequence to another is a “critical element” of optimal matching (MacIndoe & Abbott, 2004, 2009, p. 391). Various approaches to optimal matching have been tested (Biemann, 2011; Billari & Piccarreta, 2005; Dijkstra & Taris, 1995; Elzinga, 2003; Gauthier, Widmer, Bucher, & Notredame, 2009; Halpin, 2010). This study utilizes the more commonly used methodology detailed by MacIndoe and Abbott (2004, 2009) where a substitution cost matrix is identified detailing the cost of transforming one state to another. All of the possible sequence states are displayed across the rows and columns of the matrix and the cells of...
intersection identify the costs of transformation between the two intersecting states. Transformation of one state to itself – a perfect match – has no cost, represented by the number zero.

An important aspect to setting transformation costs is how the relationship between substitution costs and insertion-deletion (indel) is defined. Indels support the analysis of sequences of differing lengths by inserting one or more states in a shorter sequence or deleting one or more states from a longer sequence. Where the length of the sequences is equal, if the indel cost is set at greater than one half of the largest substitution cost, indel will not be used by the algorithm in calculating the minimum distance between sequences. MacIndoe and Abbott (2004, 2009) suggest that indel costs should be set at 0.1 of the largest substitution cost to identify sequence patterns. However, the process of optimal matching modifies the time-orderedness of the sequence and therefore an alteration in the time relationship of the different states. Substitutions of one state for another prioritize the "timing of states", whereas indels prioritize the "occurrence of states" regardless of timing and order (Aisenbrey & Fasang, 2010, p. 426; Lesnard, 2006, 2010), as detailed in Table 4. Lesnard (2006, 2010) categorizes the indel process as "warping time...[which]...destroys the temporal links between sequences, their contemporaneity" (p. 9; p. 395) and concludes "the use of indel operations with sequences of social events can have undesirable consequences and should be avoided whenever the timing of events is crucial" (p.9). Therefore, where the theoretical focus relates to the timing and order of social events, such as in this study, high indel costs should be set so that indel is not used (MacIndoe & Abbott, 2004, 2009).

Table 4: Costs Matrix

<table>
<thead>
<tr>
<th></th>
<th>Insertion-Deletion</th>
<th>Substitution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preserved Events</td>
<td>Time</td>
<td></td>
</tr>
<tr>
<td>Altered Time</td>
<td>Event</td>
<td></td>
</tr>
</tbody>
</table>

Barban & Billari (2012, p. 769) assert that where the different sequence states have "no clear ranking", setting costs is "necessarily arbitrary". MacIndoe and Abbott (2004, 2009) suggest there may be theoretical justification for assigning higher costs to some transitions than to others, for example when the sequence states represent a hierarchy of social states. Fuller (2011) utilized sequence analysis with optimal matching and cluster analysis to map post-settlement employment trajectories for new immigrants to Canada and the relationship between employment pathway and job quality after four years. Data sequences were of equal length and timing was considered important, so indel costs were set high enough to ensure that only substitutions were used by the algorithm to align sequences. Costs were assigned on a weighted basis related to a theoretical framework of involvement in the workforce, career progression and related financial security (Fuller, 2011, p. 25).

Consideration was given to an approach based on the theoretical foundations of Fuller's (2011) assessment of costs, weighting substitution costs on the social characteristics of enrolment and achievement categories which appear in the sequence of states. This approach however raises the question of how to assign value to the social characteristics of different enrolment and achievement categories given that there are indications that students do not value enrolment and achievement the same way that PSE institutions and government policy do. As well, some transitions are less likely to occur than others and theoretical costs might not adequately reflect this. Abbott (2000) advocates using information about the relevant transitions to set costs. Consistent with the exploratory nature of this study and to avoid attaching externally derived values to the different states and transitions, substitution costs in the matrix are set based on the transition rates between states, derived from the actual dataset.

To create the distance matrix based on the transition costs, for the reasons discussed above, costs of substitution are set high enough to ensure that inserts and deletions are not used (Fuller & Martin,
The academic pathways are conceptualized as of equal length – one possible enrolment status is *not enrolled*. One could argue that this status should not be used where a student has already successfully completed and graduated from a program. However, it is not uncommon for a student to complete one diploma and continue with a second course of study as in the sample sequence for student C above. In 2008, Humber introduced four business degree programs, with a fifth added in fall 2011. Graduates of two and three-year business diplomas are eligible to apply to transfer with advanced standing to these degree programs. Given the opportunities available, the practice of some students to return for further education after graduation, and the importance of pathways reflecting all institutional statuses, sequences are considered as equal even post-graduation.

The transition-rate-based substitution costs are used in the calculation of dissimilarity between individual sequences; they represent the minimum cost of transforming one sequence into another. The cost depends on the number of substitutions required and the costs assigned to each transformation in the matrix. A distance matrix is produced from calculating the dissimilarities of every pair of sequences in the sample. The complete distance matrix is a 790 x 790 cell matrix. A partial distance matrix based on the substitution costs from transition rates for the first 10 sequences in the dataset is shown in Table 5. There is no cost for substitution of one sequence for the same sequence, shown by the diagonal cell values of 0.00000. Although not filled in, the values above the zero diagonal are the same as below the diagonal for the identical pairs of sequences.
Table 5: Partial Distance Matrix for First 10 Sequences

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>25.759</td>
<td>0.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>27.963</td>
<td>18.536</td>
<td>0.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>26.601</td>
<td>14.866</td>
<td>24.288</td>
<td>0.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>30.536</td>
<td>13.420</td>
<td>27.907</td>
<td>15.198</td>
<td>0.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>26.068</td>
<td>9.812</td>
<td>24.249</td>
<td>8.102</td>
<td>10.082</td>
<td>0.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>27.987</td>
<td>13.099</td>
<td>24.285</td>
<td>6.481</td>
<td>9.899</td>
<td>6.336</td>
<td>0.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>23.840</td>
<td>3.350</td>
<td>18.334</td>
<td>15.067</td>
<td>15.127</td>
<td>11.445</td>
<td>13.301</td>
<td>0.000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The distance matrix is used with cluster analysis. Four, five and six cluster patterns with both hierarchical, based on Ward's algorithm, and partitioning around medoids clustering methodologies, and the exercise of judgement (Fuller, 2011; Gabadinho et al., 2011) were used to group similar sequences together (those with low transformation costs) according to a typology of trajectory. Increasing the number of clusters to five and six clusters merely subdivided one cluster from the four cluster group into smaller and smaller groups of sequences. Based on measures of cluster quality, it was concluded that four clusters using hierarchical agglomeration with Ward's algorithm was the best fit.

As is common with sequence analysis with optimal matching and cluster analysis with social science data, clustered sequences are described and used as dependent variables in regression analysis to explore the existence of predictor variables of those pathways from student demographic, prior academic or college entry characteristics. Studer et al. (2011) argue that it is insufficient to conclude the analysis at this stage, as diverse sequences are represented by a limited number of clusters,
inherently disregarding information on both the intra-cluster and inter-cluster variability. One result may be inaccurate conclusions regarding relationships with covariates.

Following the methodology of Studer et al. (2011) the derived clusters of pathways are therefore evaluated for quality to measure the homogeneity of sequences within each cluster, using average silhouette width (ASW). Average silhouette width, \( s(i) \), a measure devised by Rousseeuw (1987), is a ratio comparing the within cluster dissimilarity (how close the objects in one cluster are to each other) to the between cluster dissimilarity (how close the objects in one cluster are to the objects in the other clusters). Measures close to 1 indicate the within cluster dissimilarity is smaller than the dissimilarity between clusters suggesting that that each object \( i \) is assigned to the correct cluster. Measures close to -1 suggest that each object \( i \) should more properly be assigned to a different cluster (Rousseeuw, 1987, p. 56).

Discrepancy analysis is then used to identify inter-individual differences in student sequence pathways and explore associations between differences in individual student pathways and demographic, prior academic, and college entry characteristics as independent predictors. Studer et al. (2011) suggest discrepancy analysis as a solution to the loss of variation in individual sequences when clustered into typologies of sequences and used in regression with predictor variables. With discrepancy analysis, the dissimilarities, or optimal matching distances between every pair of sequences, is used to calculate the sequence discrepancy. Analysis of variance is then used to identify that part accounted for by the independent variables. For the detailed conceptual and mathematical construction of this approach, please see Studer et al. (2011).

**Literature Support for Analytical Methods**

Evidence suggests that pathways are diverse, non-linear, and multi-directional as individual students move in and out of various states or statuses from term to term including full-time, part-time, not
enrolled or academically withdrawn, and achieve different levels of academic success by the end of each term. These pathways can be identified as temporally ordered sequences of states and statuses.

The use of event history analysis, also called survival analysis, is not uncommon with Canadian research into student PSE success over time (for example, Ma & Frempong, 2008), and focuses on one or more events as transitions, such as graduation or dropping out. In the most recent Ontario research based on YITS cohorts A and B, Finnie et al. (2010, 2012) used survival analysis with the transitions of graduation, program switching, or withdrawing from PSE prior to graduation for individual students across two spells – when students first enrol in PSE and upon their return if they left before graduation.

Sequence analysis with optimal matching is a more recent technique in the social sciences and has not been without critical debate (see Abbott, 2000; Abbott & Tsay, 2000; Levine, 2000; Wu, 2000); however, advances in methodology have addressed the issues identified (Aisenbrey & Fasang, 2010). Sequence analysis is considered as a complementary technique to event history analysis in life course research (Aisenbrey & Fasang, 2010; Billari, 2001, 2005) and one that can analyse multiple, sequential events or states as a unit with the goal of identifying units which represent more typical and more meaningful pathways for a group of individuals (Billari, 2001). Aisenbrey and Fasang (2010) describe four ways sequence analysis adds value:

(a) It provides a methodological implementation of the theoretically emphasized trajectory concept, (b) it enables precise measurement of the central processes of de-standardization and differentiation of life course patterns, (c) it is not based on any assumptions about the processes that generate data, and (d) it provides a comprehensive perspective that is informative on subgroups of the population that are not at risk of experiencing certain predefined transitions. (p. 423)
Aisenbrey & Fasang (2010), reiterating and expanding on Abbott (2000), assert that the conceptual underpinnings, purpose, scientific tradition and assumptions about data of event history analysis and sequence analysis are fundamentally different (see Table 6).

Table 6: Comparison of Event History Analysis and Sequence Analysis in Life Course Sociology

<table>
<thead>
<tr>
<th></th>
<th>Event History Analysis</th>
<th>Sequence Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theoretical concept</td>
<td>Transition/duration</td>
<td>Trajectory</td>
</tr>
<tr>
<td>Objective to identify...</td>
<td>Probability of single transitions/durations</td>
<td>Temporal patterns of sequential equivalence</td>
</tr>
<tr>
<td>Scientific tradition</td>
<td>Stochastic data modeling culture</td>
<td>Algorithmic modeling culture</td>
</tr>
<tr>
<td>Assumptions about data</td>
<td>Generated by stochastic process</td>
<td>None/&quot;black box&quot;</td>
</tr>
</tbody>
</table>

Sequence analysis with optimal matching has been supported conceptually for demographic research (Billari, 2001) and for research in psychology (Ivanouw, 2007). Billari (2005) suggests that sequence analysis methodologies from the algorithmic culture should be used when questions relate to inter alia, “what are the key factors that differentiate life courses in their unity” (p. 277).

Andres & Offerhaus (2012) apply sequence analysis to describe pathways in the twenty-two year span of longitudinal data from the Paths on Life’s Way project, and conclude that

> sequence analysis is ideal for life course research as it uses variables or elements with certain states…that can be ordered into sequences; then, the sequential nature of all elements can be examined simultaneously. The sequence then serves as a representation of an individual’s pathway. (p. 1)

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3 Abbott (2000) “[Optimal matching] algorithms are not models, nor are they premised on models. That is the foundation of their difference from standard methodologies. They simply look for patterns or regularities. The type of regularity they seek can be varied by varying the structure and parameters of the algorithm. But the algorithms do not rest, ultimately, on an ideal of how the data are generated.” (p. 67)
Sequence analysis with optimal matching and cluster analysis has been used to describe and analyze varied trajectories, including those relating to career trajectories in East Germany (Sackmann, Windzio, & Wingens, 2001); the transition to adulthood of Canadian men (Ravanera, Fernando, Burch, & Le Bourdais, 2002); the transition of British young adults from school to work (McVicar & Anyadike-Danes, 2002); female employment and family trajectories in Britain (Aassve, Billari, & Piccarreta, 2005); the interrelated transitions of employment, housing and family careers (Pollock, 2007); school to work transitions comparatively across ten European countries (Brzinsky-Fay, 2007); economic transition to adulthood for two British cohorts (Martin et al., 2008); senior management career trajectories comparatively across five countries (Biemann & Wolf, 2009), and immigrant employment trajectories in West Germany (Kogan, 2007) and in Canada (Fuller, 2011).

Research that has employed sequence analysis with optimal matching and cluster analysis and has taken the additional step of employing regression techniques to explore the association of trajectory type with prior characteristics includes the McVicar and Anyadike-Danes (2002) analysis of the monthly transition of 712 British youth from school to work and the effect of individual, school and family characteristics on the different trajectory clusters. Anyadike-Danes & McVicar (2010) explored the annual states of 5,000 British women in transition from education to work and the predictors associated with trajectory type. Havlicek (2010) tracked the foster placement history of 474 youth in the state of Illinois and identified co-variates related to placement pattern. Most recently Fuller & Martin (2012), building on the research of Fuller (2011), explored the determinants of post-settlement immigrant employment pathways.

As noted, Studer et al. (2011) further develop the analytical techniques to evaluate the quality of the clusters obtained through sequence analysis with optimal matching and apply discrepancy analysis to explore relationships between co-variates and the dissimilarities between individual sequences.
Limitations of Analytical Techniques

This research study is an exploratory longitudinal study of the academic pathways of one cohort of students in four general business diploma programs at one Ontario college. The research design and methodological techniques used do not identify causal relationships but rather describe pathways and transitions and explore associations between student demographic, prior academic, and college entry characteristics, and academic pathways and outcomes.

A student’s PSE academic pathway does not exist in isolation from his or her family, work and housing circumstances. An exploration of the dynamics of educational trajectories alone with individual student academic and behavioural predictor indices is therefore an incomplete contextual exploration. It is clear that students who experience limiting factors arising from challenging family, job or housing circumstances (interdependent life spheres) and those who have exercised agency to focus on opportunities outside of the college will likely demonstrate differing academic pathways. It may be possible to identify a challenged or otherwise-focused trajectory without knowing exactly what is contributing the challenge or external focus.

Summary

In this chapter I have detailed the research methodology including the literature support for and the limitations of the specific analytical techniques used. The following two chapters detail the research findings: Chapters Four and Five detail the descriptive and analytical findings for the academic outcome variables and for academic pathways, respectively. The recommendations and conclusions drawn from the research results are discussed in the final chapter.

Sequence analysis with optimal matching and cluster analysis is a relatively new methodology with longitudinal data in the social sciences. A more commonly used technique is event history, or survival analysis, which measures the duration of time until the occurrence of a particular event.
With research on student persistence, survival analysis has focussed on one or more events such as graduation, leaving PSE or returning to PSE. The critical advantage to sequence analysis is that it supports analysis of multiple sequential events or states, temporally ordered, as a unit and highlights the commonality and diversity of patterns among the individual sequences, necessary to answer the research questions on student academic pathways. Performing sequence analysis with optimal matching and cluster analysis with the statistical and computing platform R permits visualization of these patterns; with the current dataset, student academic pathways can be seen in their entirety, including the identification of salient pathway characteristics via the colour coding of the individual enrolment and achievement states and the identification of typologies of sequences. Important for an exploratory study such as this one, sequence analysis does not depend on assumptions about the underlying data. Optimal matching with cluster analysis and discrepancy analysis support the exploration of relationships between independent variables and the academic pathways represented by sequences.
Chapter Four: Independent Variables and Academic Outcomes – Descriptive and Analytical Findings

The purpose of this chapter is to address research Question 1: In what ways, if any, does student academic achievement, represented by course and credential completion, and student persistence, represented by course enrolment, at Humber College differ from the policy-mandated, reported graduation rate? and Question 2: In what ways, if any, do the demographic, prior academic, or college entry characteristics of students at Humber College appear related to student academic achievement and persistence? The chapter details the characteristics of the dataset and the descriptive and analytical findings for the academic outcome variables. First the demographic, prior academic and college entry characteristics of the 2006 cohort are described. Next, prescribed student postsecondary educational outcomes are presented, followed by the research-defined academic outcome measures graduate with a diploma or higher credential, total courses enrolled, total courses passed and course completion rate. The third section details the results of linear and logistic regression analysis of these outcome measures with the student characteristic covariates. The final section summarizes the research findings for these academic outcome measures.

Description of Demographic, Prior Academic and College Entry Characteristics

Demographic characteristics of the students in the final dataset (N = 790) are displayed in Table 7 below. Almost two-thirds of the student group are male (62.5%) and slightly more than one-third are female (37.5%). More than 80% of the students were born in Canada. The majority of students are between the ages of 17-20 (73.3%), with only 36 students, or 4.6%, age 25 or over.
Table 7: Demographic Characteristics of Cohort

<table>
<thead>
<tr>
<th>Demographic Characteristic</th>
<th>Students</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>494</td>
<td>62.5</td>
</tr>
<tr>
<td>Female</td>
<td>296</td>
<td>37.5</td>
</tr>
<tr>
<td>Total</td>
<td>790</td>
<td>100.0</td>
</tr>
<tr>
<td>Birthplace/Citizenship</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>642</td>
<td>81.3</td>
</tr>
<tr>
<td>Other</td>
<td>148</td>
<td>18.7</td>
</tr>
<tr>
<td>Total</td>
<td>790</td>
<td>100.0</td>
</tr>
<tr>
<td>Age in 2006 (range 17-46)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17-18</td>
<td>210</td>
<td>26.6</td>
</tr>
<tr>
<td>19-20</td>
<td>369</td>
<td>46.7</td>
</tr>
<tr>
<td>21-22</td>
<td>124</td>
<td>15.7</td>
</tr>
<tr>
<td>23-24</td>
<td>50</td>
<td>6.3</td>
</tr>
<tr>
<td>25 and over</td>
<td>36</td>
<td>4.6</td>
</tr>
<tr>
<td>Unknown</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Total</td>
<td>790</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Characteristics of prior academic trajectories include Grade 9 and 12 mathematics and English course types and final grades, and estimated final high school GPA. As previously noted, information on high school courses and grades is limited; it is available for approximately 15% of the students (grade 9, n = 108; grade 12, n = 132-137) in the fall 2006 entry cohort. Table 8 provides details of the mathematics and English course streams for these students, applied or academic in grade 9 and college or university in grade 12. The symbol N/A indicates those students for whom high school course information was not available in the dataset. It is likely that many of these students had high school English and mathematics credits at college entry as both a grade 12 English and a grade 12 mathematics course are part of the admissions requirements for the programs under study. What is not known is which students entered with each type of high school course credit or which students were missing one or more. Research previously reviewed in Chapter 2 is suggestive regarding proportions. King and Warren's (2006) survey of approximately 21,000 senior Ontario high school students (including almost 6,000 students from the area of Toronto which includes Humber) found that more than 50% of direct-entry-to-college students were
enrolled in college level courses in grades 11 and 12 and King et al. (2009) identified male students (which comprise 62.5% of this cohort) as less likely to have taken academic courses in early high school or university courses in later high school. Given the importance of high school course information to the characterization of prior academic pathway and that specific details are available for approximately 15% of the cohort, the variable is retained in the analysis with a caveat regarding interpretation. It is not possible to infer homogeneity of variance with the subpopulations relating to the N/A group and the group of students for which we have high school course data.

In grade 9, more than 60% of the students for whom information is available were enrolled in an academic mathematics or English course. In early high school therefore, a minority of this sub-group of students was on a non-university pathway enrolled in applied mathematics and English courses. By the time these students reached grade 12, the enrolment patterns had reversed. The majority was enrolled in college level mathematics (81.8%) and English (67.9%) courses; far fewer were on a university pathway. The majority of the students in this sub-group of the cohort therefore did not have the senior high school level courses to be eligible to attend university; college was the only available PSE pathway. A large proportion of students with available information on high school course type enrolled in applied courses in grade 9 and college level courses in later grades, likely with little or no understanding of the effect on future educational and career opportunities and pathways, suggesting that in Ontario some students are encouraged to make choices or follow a direction in high school which will lead to a subsequent lowering of aspirations (Brint & Karabel, 1991), possibly part of a cooling out process (Clark, 1960).
Table 8: Grade 9 and Grade 12 Mathematics and English Courses

<table>
<thead>
<tr>
<th>Course Stream</th>
<th>Students</th>
<th>%</th>
<th>Cohort %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 9 Mathematics Course</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Academic</td>
<td>67</td>
<td>62.0</td>
<td>8.5</td>
</tr>
<tr>
<td>Applied</td>
<td>41</td>
<td>38.0</td>
<td>5.2</td>
</tr>
<tr>
<td>N/A</td>
<td>108</td>
<td>100.0</td>
<td>13.7</td>
</tr>
<tr>
<td></td>
<td>682</td>
<td>86.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>790</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Grade 12 Mathematics Course</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>College</td>
<td>108</td>
<td>81.8</td>
<td>13.7</td>
</tr>
<tr>
<td>University</td>
<td>24</td>
<td>18.2</td>
<td>3.0</td>
</tr>
<tr>
<td>N/A</td>
<td>132</td>
<td>100.0</td>
<td>16.7</td>
</tr>
<tr>
<td></td>
<td>658</td>
<td>83.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>790</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Grade 9 English Course</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Academic</td>
<td>69</td>
<td>63.9</td>
<td>8.7</td>
</tr>
<tr>
<td>Applied</td>
<td>39</td>
<td>36.1</td>
<td>4.9</td>
</tr>
<tr>
<td>N/A</td>
<td>108</td>
<td>100.0</td>
<td>13.7</td>
</tr>
<tr>
<td></td>
<td>682</td>
<td>86.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>790</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Grade 12 English Course</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>College</td>
<td>93</td>
<td>67.9</td>
<td>11.8</td>
</tr>
<tr>
<td>University</td>
<td>44</td>
<td>32.1</td>
<td>5.6</td>
</tr>
<tr>
<td>N/A</td>
<td>137</td>
<td>100.0</td>
<td>17.4</td>
</tr>
<tr>
<td></td>
<td>653</td>
<td>82.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>790</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

The range for final high school GPA and grade 12 mathematics grade for these students is large, from 30%-91% and 35%-91%, respectively, demonstrating that some cohort students were admitted to the program of entry having failed to complete a grade 12 mathematics course. Grades for grade 9 mathematics and grade 9 and 12 English range from a low of 50% to highs of 85%-92%. Scatterplots (not shown) of grade 9 and grade 12 mathematics and English grades suggest no relationship in grades from grade 9 to grade 12 for individual students.

College entry characteristics in the dataset include initial program selection and the ranking of that program through OCAS, the online portal for Ontario college applicants. College entry characteristics also include the timing of the student application and subsequent enrolment in the
program, transfer credit(s) granted by the college for courses taken at another PSE institution or as a dual credit during high school, arithmetic and algebra scores achieved on the mathematics placement test prior to first term, and mathematics and English course placement in first term.

Table 9 shows the distribution of entry program for the 2006 cohort. The three-year Business Administration advanced diploma program was the most popular program with almost 43% of the cohort enrolment, followed by the two-year Business Management diploma program with approximately 30% of the intake, both offered at two campuses. Marketing Management, a two-year, more specialized program, is third in enrolment preference with 14.8% of the intake. The three-year advanced Business Administration diploma program with two co-op work terms has the lowest intake enrolment (12.5%).

Table 9: Distribution of Cohort Entry Program Fall 2006

<table>
<thead>
<tr>
<th>Program</th>
<th>Students</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Management (BM - 2 year)</td>
<td>235</td>
<td>29.7</td>
</tr>
<tr>
<td>Marketing Management (MM - 2 year)</td>
<td>117</td>
<td>14.8</td>
</tr>
<tr>
<td>Business Administration (BAR - 3 year)</td>
<td>339</td>
<td>42.9</td>
</tr>
<tr>
<td>Business Administration Co-op (BAC - 3 year)</td>
<td>99</td>
<td>12.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>790</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Tables 10 and 11 show the distributions of student choice through OCAS of their program of enrolment for fall 2006. Just over half of the students (51.6%) were enrolled in their first choice program, followed by another 19% enrolled in their second choice program. Thirteen and one half percent of students were enrolled in a program ranked third. Twenty-one students (2.7%) applied directly to the college, identified as OCAS choice 6. More than half of the cohort (54.3%) therefore prioritized their initial program of enrolment at Humber (selections 1 and 6) whereas 13.2% of students ranked the Humber-program combination as least desirable compared to other options (selections 4 and 5).
Table 10: Distribution of OCAS Choice

<table>
<thead>
<tr>
<th></th>
<th>Students</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>408</td>
<td>51.6</td>
</tr>
<tr>
<td>2nd</td>
<td>150</td>
<td>19.0</td>
</tr>
<tr>
<td>3rd</td>
<td>107</td>
<td>13.5</td>
</tr>
<tr>
<td>4th</td>
<td>61</td>
<td>7.7</td>
</tr>
<tr>
<td>5th</td>
<td>43</td>
<td>5.5</td>
</tr>
<tr>
<td>6th</td>
<td>21</td>
<td>2.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>790</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Table 11: OCAS Choice Bivariate Distribution

<table>
<thead>
<tr>
<th></th>
<th>Students</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 6 Highest prioritized</td>
<td>429</td>
<td>54.3</td>
</tr>
<tr>
<td>2, 3 Medium prioritized</td>
<td>257</td>
<td>32.5</td>
</tr>
<tr>
<td>4, 5 Lowest prioritized</td>
<td>104</td>
<td>13.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>790</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Table 12 details the distributions of the timing of student applications and enrolment to the fall 2006 entry programs and transfer credits. More than 75% of the students applied to their entry program prior to July 1, 2006, and more than 96% of students had applied and were enrolled in courses by September 1, 2006, having paid either tuition or a deferral fee for late payment of tuition. Seventy-one students (9%) in the cohort entered with transfer credits and therefore had a reduced number of courses to complete the program. These students entered Humber with some prior successful PSE experience although most, if not all, were likely considered a dropout from the previous institution.

Table 12: Timing of Application and Transfer Credit(s)

<table>
<thead>
<tr>
<th></th>
<th>Students</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied by July 1, 2006</td>
<td>Yes</td>
<td>611</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>179</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>790</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

| Applied and enrolled by September 1, 2006 | Yes | 760 | 96.2 |
| | No | 30  | 3.8  |
| **Total** | **790** | **100.0** |

| Transfer Credit(s) | Yes | 71  | 9.0 |
| | No | 719 | 91.0 |
| **Total** | **790** | **100.0** |

After acceptance of an offer of admission and before the start of classes, all students entering a business diploma program complete mathematics and English writing placement tests to identify
whether skill levels in these areas are sufficient for success in program level courses. There are two possible mathematics course placements – remedial or program level, and four possible English course placements – remedial, program level, remedial ESL, and program level ESL. The ESL course sections are considered equivalent to the regular program and remedial sections, with modified course delivery designed to support skill acquisition for students for whom English is not their first language. Table 13 details course placements for the fall 2006 cohort. As a cohort, a large proportion of entering students displays mathematics skills and/or English writing skills below the level necessary for academic success. More than 43% of the students were placed in remedial mathematics, BMAT 110; the balance was placed in the program level mathematics course, BMAT 220. The distribution of English placements shows that almost 70% of the students were placed in program level English, 62% in the regular course, COMM 200, and 6.7% in the ESL program course, ESL 200. Just over 28% of the students were placed in a remedial English course, 21.3% in COMM 100 and 6.8% in remedial ESL, ESL 150. Overall, 13.5% of the students were placed in ESL courses. A small number of students were exempt from the first term English course based on demonstrated writing skills or transfer credits from prior PSE study.

Table 13: Mathematics and English Course Placement Fall 2006

<table>
<thead>
<tr>
<th>Mathematics Placement</th>
<th>Course Code</th>
<th>Students</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remedial Mathematics</td>
<td>BMAT 110</td>
<td>344</td>
<td>43.5</td>
</tr>
<tr>
<td>Program-level Mathematics</td>
<td>BMAT 220</td>
<td>446</td>
<td>56.5</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>790</td>
<td>100.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>English Placement</th>
<th>Course Code</th>
<th>Students</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remedial English</td>
<td>COMM 100</td>
<td>168</td>
<td>21.3</td>
</tr>
<tr>
<td>Program-level English</td>
<td>COMM 200</td>
<td>492</td>
<td>62.3</td>
</tr>
<tr>
<td>Remedial English for ESL students</td>
<td>ESL 150</td>
<td>54</td>
<td>6.8</td>
</tr>
<tr>
<td>Program-level English for ESL students</td>
<td>ESL 200</td>
<td>53</td>
<td>6.7</td>
</tr>
<tr>
<td>Exempt</td>
<td></td>
<td>17</td>
<td>2.2</td>
</tr>
<tr>
<td>N/A</td>
<td></td>
<td>6</td>
<td>0.8</td>
</tr>
<tr>
<td>Total ESL</td>
<td></td>
<td>107</td>
<td>13.5</td>
</tr>
<tr>
<td>Total Remedial</td>
<td></td>
<td>222</td>
<td>28.1</td>
</tr>
</tbody>
</table>
Mathematics placement test scores for cohort students display a wide range, 24-119 out of a maximum of 120 on the arithmetic portion of the test and 21-119 out of a maximum of 120 on the algebra portion of the test. Total scores (sum of arithmetic and algebra scores) ranged from 47-238 out of 240. One student was exempt from placement testing. Arithmetic scores were not provided for 7 students and algebra scores were not provided for 8 students. The scatterplot in Figure 11 shows the relationship between student placement test arithmetic scores and algebra scores. Student algebra skills appear weaker than arithmetic skills. Most students' algebra scores are lower than their arithmetic scores, demonstrating that mathematics skills are not uniform across the range of expected proficiencies at college entry, supporting research from the College Mathematics Project (Orpwood et al., 2012) regarding limitations on student attainment of mathematics skills from the middle grades (grades 6-8) provincial mathematics curricula.

Figure 11: Scatterplot of Arithmetic and Algebra Placement Test Scores
Contingency tables by sex were built with the demographic, prior academic and college entry characteristics. Based on Pearson Chi-squared tests with Yates’ continuity correction, no significant associations were found between sex and age, high school course stream, OCAS choice, timing of application and enrolment, transfer credit(s), or mathematics or English course placement. The only significant association by sex relates to fall 2006 entry program where the enrolment pattern shows a higher proportion of male students enrolled in the two-year Business Management diploma program than expected ($x^2 = 7.9632$, $df = 1$, $p$ value = 0.004774). This program is the shortest, most generic business program offered by Humber which suggests that male students may have a preference for a more general credential with a shorter time to completion.

Additional information is obtained when the final program of enrolment is explored. Humber has more than 125 programs across more than 40 fields of study, including one-year certificates, apprenticeships, two and three-year diplomas, four-year degrees and one and two-year postgraduate certificate programs. Students are able to transfer easily among the four programs under study, and some of the course credits from these programs are transferable to entirely different programs within the college. Table 14 provides information about the last program of enrolment for the cohort students. In general, students demonstrate a tendency to migrate to the shorter and less structured business diploma programs. The two-year programs, Management and Marketing, experience a net gain of students whereas the three-year programs experience a net loss. Given the identified weaknesses in student mathematics skills at entry, this is not surprising. The curriculum of the three-year programs includes more quantitative courses, including finance and statistics, compared to the two-year programs. Business Administration Co-op, the most structured of the four programs with 8 consecutive terms, 6 terms of classroom study and two summer co-op work terms, loses the most students – more than two thirds of its students exited the program during the research period. If the students initially attracted to the co-op program for the work term experience are unable to follow a rigid program structure for that length of time, it is reasonable to
expect they will transfer to shorter and/or more flexible programs once this incongruence becomes apparent. For 99 students (12.6% of the cohort), their final program of enrolment is quite different from the program initially chosen. This suggests that the general business diploma programs are a default choice for many students who may be unsure of their career path and act as an exploratory pathway into PSE. Subsequently, students decide that their interests lie elsewhere and find alternate pathways both within Humber and within other institutions.

Table 14: Final Program of Enrolment

<table>
<thead>
<tr>
<th>Program</th>
<th>Students</th>
<th>%</th>
<th>Program (continued)</th>
<th>Students</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Admin. Adv. Dipl. (at entry n = 339)</td>
<td>286</td>
<td>36.2</td>
<td>Culinary Management Diploma</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Business Management Dipl. (at entry n = 235)</td>
<td>249</td>
<td>31.5</td>
<td>Human Resources Management Postgrad. Cert.</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Business Marketing Diploma (at entry n = 117)</td>
<td>126</td>
<td>15.9</td>
<td>Heating, Refrigeration, Air Cond. Tech. Adv. Dipl.</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Bus. Admin. Co-op Adv. Dipl. (at entry n = 99)</td>
<td>30</td>
<td>3.8</td>
<td>Public Relations Advanced Diploma</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Accounting Advanced Diploma</td>
<td>8</td>
<td>1.0</td>
<td>Film and Television Production Advanced Dipl.</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Accounting Diploma</td>
<td>7</td>
<td>0.9</td>
<td>Broadcasting Radio Diploma</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Police Foundations Diploma</td>
<td>6</td>
<td>0.8</td>
<td>Electrician: Construction &amp; Maint. Apprenticeship</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Esthetician/Spa Management</td>
<td>6</td>
<td>0.8</td>
<td>Practical Nursing Diploma</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Architectural Technology Advanced Diploma</td>
<td>4</td>
<td>0.5</td>
<td>Bachelor of Nursing</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Plumber Apprenticeship</td>
<td>4</td>
<td>0.5</td>
<td>Pharmacy Technician Diploma</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Early Childhood Education Diploma</td>
<td>4</td>
<td>0.5</td>
<td>General Arts &amp; Science College Tsf./Dipl.</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Fashion Arts Diploma</td>
<td>4</td>
<td>0.5</td>
<td>General Arts and Science Special Topics</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Human Resources Mgmt. - Bachelor of Comm.</td>
<td>4</td>
<td>0.5</td>
<td>Media Foundations Certificate</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Law Clerk Diploma</td>
<td>3</td>
<td>0.4</td>
<td>Community and Justice Services Diploma</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>General Arts &amp; Science University Tsf./Dipl.</td>
<td>3</td>
<td>0.4</td>
<td>Game Programming Advanced Diploma</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>General Arts and Science Tech Profile Certificate</td>
<td>3</td>
<td>0.4</td>
<td>Media Communications Diploma</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Hotel and Restaurant Management Diploma</td>
<td>2</td>
<td>0.3</td>
<td>Tourism Mgmt. - Travel Industry Services Dipl.</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Heating, Refrigeration, Air Cond. Technician Dipl.</td>
<td>2</td>
<td>0.3</td>
<td>Massage Therapy Advanced Diploma</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Electronics Engineering Technology Adv. Dipl.</td>
<td>2</td>
<td>0.3</td>
<td>Professional Golf Management Advanced Dipl.</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Advertising - Media Sales Diploma</td>
<td>2</td>
<td>0.3</td>
<td>Computer and Network Support Technician Dipl.</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Advertising Copywriting Postgraduate Certificate</td>
<td>2</td>
<td>0.3</td>
<td>Cosmetic Management Diploma</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Tourism and Hospitality Management Diploma</td>
<td>2</td>
<td>0.3</td>
<td>Financial Planning Postgraduate Certificate</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Financial Services Diploma</td>
<td>2</td>
<td>0.3</td>
<td>Bachelor of Public Relations</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Paralegal Education Diploma</td>
<td>2</td>
<td>0.3</td>
<td>Project Management Postgraduate Certificate</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Landscape Technician Diploma</td>
<td>1</td>
<td>0.1</td>
<td>Sustainable Energy &amp; Building Tech. Adv. Dipl.</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Food and Beverage Service Certificate</td>
<td>1</td>
<td>0.1</td>
<td></td>
<td>790</td>
<td>100.0</td>
</tr>
</tbody>
</table>

132
Traditional Postsecondary Education Outcome Measures

As described in Chapter 1, traditional PSE outcome measures include graduation rate and retention from one term or year of enrolment to the next. Humber reports graduation rate by program to meet government KPI reporting requirements of the percentage of full-time students completing a program within 200% of the regular program length. Retention rate is the percentage of full-time students in an entry cohort who continue to be enrolled full time the following year. The primary focus is retention from first to second year. Both of these measures are emphasized internally and by the literature on PSE student success as measures of institutional effectiveness. Table 15 details the first to second year retention rates and program graduation rates for the fall 2006 cohort, based on institutional information. First to second year retention rates, which range from 66.1% for Business Management to 82.5% for Business Administration Co-op, are significantly higher than graduation rates, ranging from 21.3% for Business Administration Co-op to 56.5% for Business Marketing, indicating that many students do not complete the program. Institutional reports identify 362 students across the four programs as graduating within the required time period, a weighted average graduation rate of 45.8% (not shown). The longest and most structured program, Business Administration Co-op, has the lowest graduation rate; the most specialized program and one of the shorter programs, Business Marketing, has the highest graduation rate. This suggests that highly structured programs such as Business Administration Co-op may not be a fit for many students and shorter, more generic programs with less clear pathways to the workforce such as Business Management may struggle to keep students engaged. As measures of institutional and student success, the information conveyed by retention rate and graduation rate is quite limited. Missing are details on student transfers in or out of each program, the number of students who complete a program earlier or later than 200% of the program length, average time-to-completion, and course completion by students who do not graduate.
Table 15: Fall 2006 Cohort Retention and Graduation Rates by Program

<table>
<thead>
<tr>
<th>Program</th>
<th>Program Length</th>
<th>Retention Rate 1st - 2nd Year (%)</th>
<th>Graduation Deadline</th>
<th>Graduation Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Management</td>
<td>2</td>
<td>66.1</td>
<td>Winter 2010</td>
<td>43.0&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Business Marketing</td>
<td>2</td>
<td>74.2</td>
<td>Winter 2010</td>
<td>56.5&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Business Administration</td>
<td>3</td>
<td>73.6</td>
<td>Winter 2012</td>
<td>55.6&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Business Administration Co-op</td>
<td>3</td>
<td>82.5</td>
<td>Winter 2012</td>
<td>21.3&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup>2012 KPI report, <sup>b</sup>calculated by author from internal administrative data

Research-Defined Academic Outcome Measures

This section of the research findings details a broader spectrum of outcome measures as previously described, beyond the traditional outcome measures defined by government and institutional policy discussed above, responding to the first research question, Question 1: *In what ways, if any, does student academic achievement, represented by course and credential completion, at Humber College differ from the policy-mandated, reported graduation rate?* There are four research-defined outcome measures: (1) *graduate with a diploma or higher credential* – the number and percentage of program students who graduate during the research period with a two-year diploma, a three-year advanced diploma, a bachelor degree, or a postgraduate certificate; (2) *total courses enrolled* – the count of each student's total course enrolment during the research period; (3) *total courses passed* – the count of the number of courses enrolled in and successfully passed by each student during the research period; and (4) *course completion rate*, the ratio of *total courses passed* to *total courses enrolled*. *Total courses enrolled* is a measure of persistence. Students who continue to enrol in courses either on a full-time or part-time basis are persisting in PSE. *Total courses passed* is a measure of academic achievement with or without graduation. *Course completion rate* is an estimate of the congruence or alignment between student intention (evidenced by course enrolment) and student outcomes (evidenced by courses passed).
Graduate with a diploma or higher credential. The research-defined outcome of graduate with a diploma or higher credential accounts for all students who complete a program at the credential level of at least a two-year diploma during the research period, and includes those who complete a three-year advanced diploma, a bachelor degree and/or a postgraduate certificate. Table 16 details the range of highest credential achieved by the fall 2006 cohort students. As some students achieved more than one credential during the research period; only the highest level of credential is included to avoid double counting graduates. Almost half of the fall 2006 cohort (n = 382, 48.4%) completed one of these credentials during the research period. In comparison, as noted above, institutional reports identify 362 (45.8%) students from the cohort as graduating within the policy-mandated 200% of the regular program length completion period. The institutional graduation rate, a traditional outcome measure, therefore underreports the number of students completing a credential because the time period considered relevant is censored. Twenty students in the cohort graduated within the research period and are not reflected in the institutional graduation rate because they took longer to complete the program than considered acceptable. The graduation rate also omits one student who completed an apprenticeship and 30 students who completed a certificate, credentials which, by policy, are not included in graduation rate statistics. The credential completion of 51 students (6.5% of the cohort) is therefore disregarded.

Table 16: Distribution of Highest Credential Achieved

<table>
<thead>
<tr>
<th>Credential</th>
<th>Students</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diploma</td>
<td>204</td>
<td>25.8</td>
</tr>
<tr>
<td>Advanced Diploma</td>
<td>173</td>
<td>21.9</td>
</tr>
<tr>
<td>Degree</td>
<td>3</td>
<td>0.4</td>
</tr>
<tr>
<td>Postgrad Certificate</td>
<td>2</td>
<td>0.3</td>
</tr>
<tr>
<td>Total graduate diploma and higher credential</td>
<td>382</td>
<td>48.4</td>
</tr>
<tr>
<td>Certificate</td>
<td>30</td>
<td>3.8</td>
</tr>
<tr>
<td>Apprenticeship</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>N/A</td>
<td>377</td>
<td>47.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>790</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Total courses enrolled, total courses passed and course completion rate. The quartile range for each of the research defined outcome measures total courses enrolled, total courses passed and course completion rate for all cohort students is displayed in Table 17. For all three measures, the range is large, particularly as compared to the number of courses in the curriculum of each program: 24 for each of the two-year programs, 36 for the three-year Business Administration program, and 38 for the three-year Business Administration Co-op program. The interquartile range, between the 1st and 3rd quartiles provides a measure of the dispersion around the mid-point or median. The minimum number of total courses enrolled by a student during the research period is 1; the maximum is 79, significantly higher than the number of courses in any of the programs. Half of the students enrolled in 17-39 courses. The minimum number of total courses passed is zero; the maximum is 68, likely related to one or more students who enrolled in more than one program during the research period. Half of the cohort passed between 8-34 courses, and 25% of the students between 0-8 courses. The course completion rate ranges from a low of 0% to a high of 100% for students who passed all the courses enrolled in. During the research period, half of the cohort passed between 45.4%-91.2% of the courses enrolled in. The distribution of these three measures by frequency of student is displayed in Figures 12, 13 and 14.

<table>
<thead>
<tr>
<th>Total Courses Enrolled</th>
<th>Total Courses Passed</th>
<th>Course Completion Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>1.0</td>
<td>0.0</td>
</tr>
<tr>
<td>1st Quartile</td>
<td>17.0</td>
<td>8.0</td>
</tr>
<tr>
<td>Median</td>
<td>29.0</td>
<td>24.0</td>
</tr>
<tr>
<td>3rd Quartile</td>
<td>39.0</td>
<td>34.0</td>
</tr>
<tr>
<td>Maximum</td>
<td>79.0</td>
<td>68.0</td>
</tr>
</tbody>
</table>

As expected by the number of courses in each program curriculum (24, 36, or 38), Figure 12 shows that many students have enrolled in 20-40 courses during the research period. Very low course
enrolment counts indicate students who did not persist in PSE at Humber. Higher than expected course enrolment counts indicate students who have enrolled in more than the number of required program courses. These students may have dropped or failed courses during one or more terms and subsequently re-enrolled. Higher than expected course enrolment counts may also indicate a student who has retaken courses to raise his or her program GPA to be eligible for degree level study after graduation at Humber or another institution, or a student who has transferred between programs, possibly after graduating from the first program. For example, three students in the fall 2006 cohort graduated from both a two-year diploma and a three-year diploma and continued on to graduate with a degree in Human Resources Management in winter 2012. These students would have particularly high course enrolment and course completion counts. Higher course enrolment counts represent longer term persistence in PSE.

**Figure 12: Total Courses Enrolled by Number of Students (N = 790)**

![Histogram of Total Courses Enrolled](chart.png)

Figure 13 displays the distribution of total courses passed by individual student, a measure of academic achievement. As expected, large numbers of students complete between 20-25 courses...
(24 required courses in the two-year diploma programs), and between 35-40 courses (36-38 required courses in the three-year advanced diploma programs). There are also many students who complete significantly fewer courses than necessary for program completion. More than 150 students completed fewer than 6 courses during the research period, the equivalent of one semester of course credits, and approximately 130 students completed between 5-15 courses. Table 17 above shows that 25% of the cohort passed a maximum of 8 courses. It is not known whether these students transferred their Humber course credits to PSE programs at other institutions. If these incidental students were excluded, as suggested by Adelman (2000), from the calculated graduation rate for KPI purposes, the graduation rate would be larger than reported and arguably more representative of the graduation rate for students committed to the program of enrolment at Humber.

At the other extreme, course completion counts over and above expected counts for the programs of study suggest students who have transferred to one or more other Humber programs after completing or substantially completing a previous one. The number of students completing some courses and not graduating with a diploma or higher credential is larger than the number of graduates. This represents unacknowledged academic achievement as only graduates are recognized by the PSE institution and system as having achieved success.
The *course completion rate* is the ratio of *total courses completed* to *total courses enrolled* and is an indication of the alignment between student academic intentions (course enrolment) and student academic outcomes (courses passed). The distribution of the *course completion rate* by student is displayed in Figure 14. Although more than 300 students completed between 80%-100% of the courses in which they were enrolled, the majority of student completion rates were lower. Low course completion rates do not necessarily indicate a student who is not persisting. There are structural parameters to program enrolment, tuition fees and financial aid for example, that may contribute to the apparent misalignment between student aspiration and achievement. Program curriculum is organized and scheduled as six courses per semester. Tuition is flat fee covering 4-6 courses per term. To qualify for maximum financial aid, students must be full time carrying a minimum course load of 67% of the full-time course load. The structure of both scheduling and fees encourages students to enrol in the maximum number of courses each term, even if that course load is too heavy when considered in light of student academic preparedness and external
responsibilities. Students are able to re-enrol in courses they have failed or dropped without restriction, and prior to fall 2014, courses which were dropped during the term did not appear on the student's academic transcript. Students with a low course completion rate may still graduate with a credential if they complete all the required courses. A student in this situation would have a longer time to completion than other more traditional students and would incur significantly higher costs. The minority of students with very high course completion rates (90%-100%, n≈220), suggests the traditional student enrolling and passing most or all courses enrolled in until graduation, is a poor representation of the students in the fall 2006 cohort.

**Figure 14: Course Completion Rate by Number of Students (N = 790)**

The relationship of total courses enrolled, total courses completed and course completion rate to graduate with a diploma or higher credential are shown in Figures 15, 16 and 17. There are clear differences in the median, inter-quartile range (IQR) and upper and lower whiskers (1.5 x IQR) of these measures between students who have graduated with a diploma or higher credential and those who have not. Figure 15 shows that minimum levels of total courses enrolled were higher for
graduates than for non-graduates whereas the range of total courses enrolled for non-graduates was greater than for graduates. One in four cohort students enrolled in at least 29 courses while not graduating with a diploma or higher credential.

Figure 15: Total Courses Enrolled by Graduate with a Diploma or Higher Credential

Figure 16 shows the median number of total courses passed was fewer than ten for non-graduates, with 25% of non-graduates passing fewer than 3 courses and another 25% passing more than 16 courses. One in four graduates passed more than 37 courses. Course completion rate (Figure 17) for non-graduates ranged from 1%-100%; course completion rate for graduates ranged from 52%-100% suggesting a minimum course completion rate of at least 50% may necessary for a student to persist to graduation.
Figure 16: Total Courses Passed by Graduate with a Diploma or Higher Credential

Non-graduate: □ 25% - 75% (3.0, 16.5) 1.5 IQR (0.0, 36.0), ◦ outlier; Graduate: □ 25% - 75% (25, 37), 1.5 IQR (14, 55), ◦ outlier
The analytical findings of the traditional and research-defined academic outcomes provide the response to research Question 1: *In what ways, if any, do student academic achievement, represented by course and credential completion, and student persistence, represented by course enrolment, at Humber College differ from the policy-mandated, reported graduation rate?* Academic achievement, as represented by course and credential completion, is more extensive and varied than as represented by the traditional outcome measure of graduation rate. Twenty more cohort students completed a credential when measured by the research-defined outcome of *graduation with a diploma and higher credential* (n = 382, 48.4%) than when measured by graduation rate (n = 362, 45.8%) and 31 students completed a credential not currently included in institutional graduation rate.
statistics. Significant additional academic achievement is represented by total courses passed by students who did not graduate with a diploma or higher credential; 4,481 courses (author calculation, not shown) were successfully completed by the 408 non-graduates in the cohort during the research period, achievement not currently accounted for despite clearly being of value to the students and more broadly. Student persistence beyond the traditional graduation rate period is inferred from the many students who enrolled in more courses than necessary to complete one of the programs in this study (24, 36, or 38); 188 students (author calculation, not shown) enrolled in 40 or more courses during the research period. The boxplots of total courses enrolled, total courses passed and course completion rate for both non-graduates and graduates with a diploma or higher credential highlight the commonalities and differences in course enrolment and achievement behaviour for these two groups of cohort students.

**Regression of Research-Defined Outcomes**

In this section the second research question is addressed: Question 2: *In what ways, if any, do the demographic, prior academic, or college entry characteristics of students at Humber College appear related to student academic achievement and persistence?* Logistic regression of the academic outcome of graduate with a diploma or higher credential and linear regression of the outcomes total courses enrolled, total courses passed, and course completion rate with student demographic, prior academic and college entry variables explores these relationships. Tables 18, 19, 20 and 21 respectively detail the results, both the full models and the most parsimonious models obtained through backwards stepwise deletion of variables from the full model in R (Crawley, 2013). The independent demographic, prior academic and college entry characteristics include both continuous and binary variables. The independent variables related to secondary school course stream are binary coded as yes, for grade 9 applied English, grade 9 applied mathematics, grade 12 college English, and grade 12 college mathematics, or no, for grade 9 academic course stream or N/A, and
grade 12 university course stream or N/A. There is therefore a known error of classification (Aigner, 1973; Hazelrigg, 2004, 2009) in that some of the students coded as N/A likely did indeed take one or more of the applied courses in grade 9 and/or college courses in grade 12 and are included in the incorrect group. Unlike a true random measurement error which is assumed to have a mean of zero and is not correlated with either the independent or dependent variable (Hazelrigg, 2004, 2009), an error of classification with a binary independent variable has a mean of other than zero and is correlated with the true part of that variable (Aigner, 1973). The effect of this classification error is to bias the results of the analysis. The variables relating to high school course stream are retained in the model subject to this caveat.

Table 18 displays the results of logistic regression of graduate with a diploma or higher credential, a measure of academic achievement, with the individual student covariates. Being male is negatively related to graduating with a diploma or higher credential. Male students have 0.5 the odds of graduating compared to female students. Students with higher algebra placement test scores are more likely to graduate with a diploma or higher credential. For every one unit increase in the algebra score, there is a 1.5% increase in the odds of graduating. Students who applied to the college by July 1, 2006 are 1.6 times as likely to graduate as those who applied later, and students with transfer credits from prior PSE are 2.5 times as likely to graduate with a diploma or higher credential. Students who took grade 12 college English appear to be half as likely to graduate as those who don't have grade 12 college English (odds ratio 0.5), however the sample size is small for variables related to type of high school course stream and the classification error noted above suggests this result may be unreliable.

Table 19 details the results of linear regression for total courses enrolled, a measure of persistence, with demographic, prior academic and college entry variables. Algebra placement test score and being placed in remedial English in first term are positively related to total courses enrolled; being
male and age in 2006 are negatively related to total courses enrolled. Having taken grade 12 college English is negatively related to total courses enrolled whereas having taken grade 9 applied English or having taken Grade 12 college mathematics are positively related to total courses enrolled. As previously noted the sample size for these high school course stream variables is small and the known classification error renders these results unreliable.

Table 20 displays the results of linear regression for the research-defined outcome of total courses passed, a measure of academic achievement, with demographic, prior academic and college entry characteristics. Male sex and age in 2006 are negatively related to total courses passed. Algebra placement test score, application by July 1, 2006 and being placed in an ESL section of English in first semester at Humber are positively related to total courses passed. Only a small amount of the variance of total courses passed is accounted for (Adjusted R-squared: 0.08047 p-value: 3.996e-13), with the most significant variables being male sex and algebra placement test score. Having taken grade 9 applied English is positively related to total courses passed whereas having taken grade 12 applied English is negatively related to total courses passed. The results for these two independent variables cannot be relied upon for the reasons previously identified.

The full model and the most parsimonious model through backward stepwise deletion of variables of linear regression for course completion rate with demographic, prior academic and college entry characteristics are displayed in Table 21. Higher course completion rates are negatively associated with male sex and positively associated with mathematics placement test algebra score, having applied by July 1, 2006, having transfer credits from prior PSE, and being placed in an ESL class in first semester at Humber. These variables together explain 11.09% of the variance in course completion rate (Adjusted R-squared: 0.1109 p-value: < 2.2e-16). As previously discussed, course completion rate can be seen as a measure of the congruence between academic intention or aspiration (total course enrolled) and academic achievement (total courses passed). There appears
to less alignment between academic plans and academic achievement for male students and students with lower algebra placement test scores, and greater alignment between academic plans and achievement for students who apply earlier to a program, those who have already achieved some postsecondary academic success, and for students who have English as a second language.

In response to Question 2: In what ways, if any, do the demographic, prior academic, or college entry characteristics of students at Humber College appear related to student academic achievement and persistence? it can be seen that being male, being an older student, and having a lower algebra placement test score upon college entry are negatively related to both academic achievement and persistence, whereas having a higher algebra placement test score, applying prior to July 1st and having transfer credits are positively related to academic achievement and persistence. Identification as an ESL student, indicated by ESL placement in first term appears to also be related to the academic achievement measures of total courses passed and course completion rate.
Table 18: Logistic Regression of *Graduate With a Diploma or Higher Credential* with Demographic, Prior Academic and College Entry Variables (N = 790)

<table>
<thead>
<tr>
<th></th>
<th>Full Model</th>
<th>Backward Model</th>
<th>Odds Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>Std. Error</td>
<td>z value</td>
</tr>
<tr>
<td>(Intercept)</td>
<td>0.004</td>
<td>0.780</td>
<td>0.005</td>
</tr>
<tr>
<td>Male sex</td>
<td>0.688</td>
<td>0.157</td>
<td>-4.380</td>
</tr>
<tr>
<td>Birthplace Canada</td>
<td>0.098</td>
<td>0.222</td>
<td>0.441</td>
</tr>
<tr>
<td>Age in 2006</td>
<td>-0.050</td>
<td>0.028</td>
<td>-1.784</td>
</tr>
<tr>
<td>Grade 9 applied English</td>
<td>0.683</td>
<td>0.584</td>
<td>1.169</td>
</tr>
<tr>
<td>Grade 12 college English</td>
<td>-1.087</td>
<td>0.406</td>
<td>-2.674</td>
</tr>
<tr>
<td>Remedial English placement</td>
<td>0.246</td>
<td>0.176</td>
<td>1.394</td>
</tr>
<tr>
<td>ESL placement</td>
<td>0.325</td>
<td>0.261</td>
<td>1.245</td>
</tr>
<tr>
<td>Grade 9 applied math</td>
<td>0.394</td>
<td>0.605</td>
<td>-0.652</td>
</tr>
<tr>
<td>Grade 12 applied math</td>
<td>0.385</td>
<td>0.372</td>
<td>1.037</td>
</tr>
<tr>
<td>Arithmetic score</td>
<td>-0.001</td>
<td>0.004</td>
<td>-0.344</td>
</tr>
<tr>
<td>Algebra score</td>
<td>0.015</td>
<td>0.004</td>
<td>3.519</td>
</tr>
<tr>
<td>Remedial math placement</td>
<td>-0.124</td>
<td>0.238</td>
<td>-0.521</td>
</tr>
<tr>
<td>Applied by July 1, 2006</td>
<td>0.442</td>
<td>0.185</td>
<td>2.381</td>
</tr>
<tr>
<td>Transfer credit(s)</td>
<td>1.052</td>
<td>0.293</td>
<td>3.591</td>
</tr>
</tbody>
</table>

*p<.05.  **p<.01.  ***p<.001

(Dispersion parameter for binomial family taken to be 1)
Null deviance: 1094.3 on 789 degrees of freedom
Residual deviance: 1009.9 on 775 degrees of freedom
AIC: 1039.9

Null deviance: 1094.3 on 789 degrees of freedom
Residual deviance: 1020.5 on 784 degrees of freedom
AIC: 1032.5
### Table 19: Linear Regression of *Total Courses Enrolled* with Demographic, Prior Academic and College Entry Variables (N = 790)

|                      | Estimate | Std. Error | t value | Pr(>|t|) | Significance | Estimate | Std. Error | t value | Pr(>|t|) | Significance |
|----------------------|----------|------------|---------|---------|--------------|----------|------------|---------|---------|--------------|
| Male sex             | -3.766   | 1.061      | -3.548  | 0.000411 | ***          | -3.862   | 1.056      | -3.656  | 0.000273 | ***          |
| Birthplace Canada    | -1.384   | 1.507      | -0.919  | 0.358560 |              | -0.368   | 0.173      | -2.131  | 0.033402 | *            |
| Age in 2006          | -0.387   | 0.179      | -2.166  | 0.030582 | *            | -0.368   | 0.173      | -2.131  | 0.033402 | *            |
| Grade 9 applied English | 8.603   | 3.791      | 2.269   | 0.023519 | *            | 8.745    | 2.819      | 3.102   | 0.001993 | **           |
| Grade 12 college English | -8.543  | 2.686      | -3.181  | 0.001526 | **           | -8.676   | 2.671      | -3.248  | 0.001212 | **           |
| Remedial English placement | 1.523   | 1.941      | 1.276   | 0.020243 |              |          |            |         |         |              |
| ESL placement        | 1.767    | 1.766      | 1.001   | 0.317350 |              |          |            |         |         |              |
| Grade 9 applied math | 1.084    | 3.928      | -0.276  | 0.782714 |              |          |            |         |         |              |
| Grade 12 college Math | 5.688   | 2.487      | 2.286   | 0.022495 | *            | 5.585    | 2.447      | 2.283   | 0.022727 | *            |
| Arithmetic score     | -0.027   | 0.029      | -0.959  | 0.337632 |              |          |            |         |         |              |
| Algebra score        | 0.105    | 0.029      | 3.605   | 0.000332 | ***          | 0.088    | 0.020      | 4.335   | 1.65E-05 | ***          |
| Remedial math placement | 0.250   | 1.586      | 0.158   | 0.874849 |              |          |            |         |         |              |
| Applied by July 1, 2006 | 2.132   | 1.239      | 1.720   | 0.085759 |              |          |            |         |         |              |
| Transfer credit(s)   | -1.278   | 1.832      | -0.698  | 0.485687 |              |          |            |         |         |              |

* p<.05. ** p<.01. *** p<.001

Residual standard error: 14.32 on 775 degrees of freedom
Multiple R-squared: 0.07332, Adjusted R-squared: 0.05658
F-statistic: 4.38 on 14 and 775 DF, p-value: 1.456e-07

Residual standard error: 14.36 on 783 degrees of freedom
Multiple R-squared: 0.05866, Adjusted R-squared: 0.05145
F-statistic: 8.132 on 6 and 783 DF, p-value: 1.519e-08
Table 20: Linear Regression of *Total Courses Passed* with Demographic, Prior Academic and College Entry Variables (N = 790)

<table>
<thead>
<tr>
<th></th>
<th>Full Model</th>
<th>Backward Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>Std. Error</td>
</tr>
<tr>
<td>(Intercept)</td>
<td>23.169</td>
<td>4.803</td>
</tr>
<tr>
<td>Male sex</td>
<td>-4.771</td>
<td>0.994</td>
</tr>
<tr>
<td>Birthplace Canada</td>
<td>-1.025</td>
<td>1.411</td>
</tr>
<tr>
<td>Age in 2006</td>
<td>-0.376</td>
<td>0.167</td>
</tr>
<tr>
<td>Grade 9 applied English</td>
<td>6.293</td>
<td>3.550</td>
</tr>
<tr>
<td>Grade 12 college English</td>
<td>-6.205</td>
<td>2.515</td>
</tr>
<tr>
<td>Remedial English placement</td>
<td>0.854</td>
<td>1.118</td>
</tr>
<tr>
<td>ESL placement</td>
<td>2.300</td>
<td>1.653</td>
</tr>
<tr>
<td>Grade 9 applied Math</td>
<td>-2.021</td>
<td>3.678</td>
</tr>
<tr>
<td>Grade 12 college Math</td>
<td>2.932</td>
<td>2.329</td>
</tr>
<tr>
<td>Arithmetic score</td>
<td>-0.009</td>
<td>0.027</td>
</tr>
<tr>
<td>Algebra score</td>
<td>0.109</td>
<td>0.027</td>
</tr>
<tr>
<td>Remedial math placement</td>
<td>-0.012</td>
<td>1.485</td>
</tr>
<tr>
<td>Applied by July 1, 2006</td>
<td>3.399</td>
<td>1.161</td>
</tr>
<tr>
<td>Transfer credit(s)</td>
<td>1.574</td>
<td>1.715</td>
</tr>
</tbody>
</table>

*p<.05.  **p<.01.  ***p<.001

Residual standard error: 13.41 on 775 degrees of freedom
Multiple R-squared: 0.09302, Adjusted R-squared: 0.07663
F-statistic: 5.677 on 14 and 7775 DF,  p-value: 1.397e-10

Residual standard error: 13.38 on 782 degrees of freedom
Multiple R-squared: 0.08863, Adjusted R-squared: 0.08047
F-statistic: 10.86 on 7 and 782 DF,  p-value: 3.996e-13
Table 21: Linear Regression of *Course Completion Rate* with Demographic, Prior Academic and College Entry Variables (N = 790)

<table>
<thead>
<tr>
<th></th>
<th>Full Model</th>
<th>Backward Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>Std. Error</td>
</tr>
<tr>
<td>(Intercept)</td>
<td>58.940</td>
<td>10.385</td>
</tr>
<tr>
<td>Male sex</td>
<td>-10.082</td>
<td>2.149</td>
</tr>
<tr>
<td>Birthplace Canada</td>
<td>-0.980</td>
<td>3.051</td>
</tr>
<tr>
<td>Age in 2006</td>
<td>-0.578</td>
<td>0.362</td>
</tr>
<tr>
<td>Grade 9 applied English</td>
<td>3.010</td>
<td>7.675</td>
</tr>
<tr>
<td>Grade 12 college English</td>
<td>-1.475</td>
<td>5.438</td>
</tr>
<tr>
<td>Remedial English placement</td>
<td>-0.588</td>
<td>2.417</td>
</tr>
<tr>
<td>ESL placement</td>
<td>7.973</td>
<td>3.575</td>
</tr>
<tr>
<td>Grade 9 applied math</td>
<td>-1.520</td>
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<td>Algebra score</td>
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<td>0.059</td>
</tr>
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<td>Remedial math placement</td>
<td>-1.299</td>
<td>3.211</td>
</tr>
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<td>Applied by July 1, 2006</td>
<td>10.775</td>
<td>2.509</td>
</tr>
<tr>
<td>Transfer credit(s)</td>
<td>13.588</td>
<td>3.708</td>
</tr>
</tbody>
</table>

*p<.05. **p<.01. ***p<.001
Residual standard error: 28.99 on 775 degrees of freedom
Multiple R-squared: 0.1225, Adjusted R-squared: 0.1066
F-statistic: 7.726 on 14 and 775 DF, p-value: <1.935e-15

*p<.05. **p<.01. ***p<.001
Residual standard error: 28.92 on 784 degrees of freedom
Multiple R-squared: 0.1165, Adjusted R-squared: 0.1109
F-statistic: 20.67 on 5 and 784 DF, p-value: <2.2e-16
Summary

The purpose of this chapter was to provide a description of the independent variables in the dataset and an analysis of the relationships between the independent variables and the research-defined academic outcome dependent variables, and by so doing, to respond to research Question 1: *In what ways, if any, does student academic achievement, represented by course and credential completion, and student persistence, represented by course enrolment, at Humber College differ from the policy-mandated, reported graduation rate?*, and Question 2: *In what ways, if any, do the demographic, prior academic, or college entry characteristics of students at Humber College appear related to student academic achievement and persistence?*

The descriptive analysis of student characteristics, final course of enrolment, and research-defined academic outcome measures for the 2006 cohort of 790 students over 19 terms provides a more detailed, complex and comprehensive picture of student PSE persistence and academic achievement than that provided by the traditional measure of PSE success – graduation rate. Students display diverse behaviour relating to course enrolment and completion and demonstrate agency in identifying program opportunities beyond those of initial enrolment, including pathways to degree level study within the institution.

The regression analyses of the research-defined academic outcomes of *graduate with a diploma or higher credential, total courses enrolled, total courses passed, and course completion rate*, summarized in Table 22, reveal that several demographic, prior academic and college entry characteristics appear related to these academic outcomes. Results of the backward stepwise analyses are generally consistent with the analyses of the full model. One of the most interesting findings, although perhaps not surprising, is that being male is negatively related to all measures at a 0.1% significance level. Male students are less likely to graduate with a diploma or higher credential than female students are, and enrol in fewer courses, pass fewer courses and have a lower course
completion rate than female students. This suggests that the male disadvantage identified at the K-12 level (King et al., 2009) continues into college PSE and is evident in lower levels of academic achievement and persistence, even in open access programs which attract a higher percentage of male students at entry.

Higher scores on the algebra portion of the mathematics placement test at college entry correlate to longer term persistence as demonstrated by total courses enrolled, increased academic achievement as demonstrated by total courses passed and graduation with a diploma or higher credential, and increased alignment between student intention and achievement as shown by course completion rate, at a 0.1% significance level. The majority of courses in the business diploma programs do not contain a large mathematics component and therefore the relationship of algebra scores to these academic outcomes measures may be in part indirect; perhaps a student’s algebra score is an indicator for overall postsecondary academic readiness. Applying to the college by July 1st and prior successful PSE as evidenced by one or more transfer credits are positively associated with the academic outcome measures related to course and credential completion. Students who have successfully completed some prior PSE and those who apply earlier in advance of the start date may be more motivated and committed to the PSE pathway chosen, or may have more personal, financial, social, and/or cultural supports to do so. Results for Grade 9 and 12 English and mathematics course streams appear to be related to some of the academic outcomes; however, as previously noted the sample size is small for these covariates and the known classification error renders these results unreliable. More research is needed to understand the relationships involved.

Co-variates which appear to be unrelated to academic outcomes include being born in Canada, arithmetic placement test score, and placement in a remedial English or mathematics course in first semester at Humber. It was suggested earlier that perhaps placement in one or more remedial courses in first semester might have a negative effect on student motivation or confidence which in
turn might affect academic outcomes. The results regarding algebra test scores suggest that knowledge and skill level rather than first semester placement is the more relevant parameter.

Overall, identified characteristics explain a relatively small amount of the variance in the measures between students and therefore are not sufficient predictors to assist with early differentiation of those students who are likely to persist and those who are not and between those likely to attain larger numbers of course credits and/or graduate and those who are not. There may be however structures and systems related to these characteristics which bear scrutiny; for example, revisiting the mathematics placement test score where students are directed to remedial mathematics class before being permitted to take the program level required mathematics course. Dialogue with high schools may also be supportive regarding clarifying the mathematics and English requirements for success at the college level.

Table 22: Summary of Demographic, Prior Academic and College Entry Variables Related to Outcomes

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total Courses Enrolled</th>
<th>Total Courses Passed</th>
<th>Course Completion Rate</th>
<th>Graduate with a Diploma and Higher Credential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male sex</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>Birthplace Canada</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age in 2006</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 9 applied English</td>
<td>**</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 12 college English</td>
<td>**</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remedial English placement</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ESL placement</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 9 applied math</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 12 college math</td>
<td>*</td>
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<td></td>
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<tr>
<td>Arithmetic score</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Algebra score</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>Remedial math placement</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Applied by July 1, 2006</td>
<td></td>
<td></td>
<td>**</td>
<td></td>
</tr>
<tr>
<td>Transfer credit(s)</td>
<td>***</td>
<td></td>
<td>**</td>
<td></td>
</tr>
</tbody>
</table>

*p<.05. **p<.01. ***p<.001
Chapter Five: Academic Pathways – Descriptive and Analytical Findings

The purpose of this chapter is to address the remaining research questions, Question 3: In what ways, if any, do the academic pathways, represented by longitudinal patterns of enrolment and achievement, of students who persist in their studies in programs at Humber College differ from those who do not persist?; and Question 4: In what ways, if any, do the demographic, prior academic, or college entry characteristics of students at Humber College appear related to student academic pathways? To do so, the chapter provides a descriptive analysis of the student academic pathways, represented by sequences of enrolment and achievement statuses as described in Chapter 3, and uses cluster analysis with optimal matching and logistic regression, and discrepancy analysis to explore the relationships between sequences and the independent covariates of demographic, prior academic and college entry characteristics.

Descriptive Findings of Sequences

In the descriptive analysis sequences are analyzed holistically, longitudinally by student and transversally by enrolment term position. Sequences are first described for the whole cohort (Figures 18-21), and then sorted by state and by group characteristic to highlight similarities and differences between groups and the diversity of patterns within groups with regard to pathways and the timing of transitions. The focus is on the demographic, prior academic and college entry characteristics found to be significant at the level of $p < .01$ for more than one of the research-defined outcomes in Chapter 4. Grade 9 Applied English is excluded due to the sample size and the known classification error. Sequence patterns are explored by academic outcome of *graduate diploma or higher credential*, and by student characteristic – sex, remedial mathematics placement as a proxy for algebra score, application date, and having transfer credit(s).
Of 790 individual student sequences of 19 enrolment/achievement states, there are 525 unique sequences revealing the diversity of individual student pathway. Figure 18 displays the 790 individual student sequences sorted from the fall 2006 state. A large majority of students are enrolled full-time (enrolled in 4 or more courses), and more than half experience high achievement (pass at least 4 courses) in the first term. Both full-time enrolment and successful completion of courses decreases from then on. Relatively few students are enrolled in the summer 2007 term, and the majority of those who are, are enrolled part-time reflecting the dominant traditional enrolment pattern of fall-winter with summer off. Figure 19 displays the individual sequences for the full cohort sorted from the end, highlighting the pattern of graduating term. By the summer of 2009, three calendar years from entry, many students continue to be enrolled revealing that many students take longer to graduate than program structure suggests. Figure 20 provides the transversal distribution of states per enrolment term, highlighting the varying proportions of the student cohort in each state. The traditional pattern of full-time, fall-winter enrolment, summer off continues to dominate. It is also clear that many students choose to not re-enrol after the first or second term, and many other students persist for a longer period of time before leaving without graduating. Although the literature and institutional discourse is particularly centred on student retention from first to second year, this suggests that ongoing retention is also relevant. Students who leave when they are close to program completion should be of particular concern given the mutual investment already made by both the student and the college, and the benefit of the earnings premium related to credential completion (Ferrer & Riddell, 2002; Riddell, 2003a).

These sequence plots provide an initial response to research Question 4: *In what ways, if any, do the academic pathways, represented by longitudinal patterns of enrolment and achievement, of students who persist in their studies in programs at Humber College differ from those who do not persist?*. Figure 19 shows that student persistence, for the cohort, decreases over time and student
pathways end after diverse enrolment-achievement states. Many students cease to persist after one or two terms of low achievement; for others, persistence ends as expected with graduation.
Figure 19: Cohort Sequences Sorted from End

Figure 20: Transversal Frequency Distributions of Cohort Sequence States at Each Time Period

- Full-time high achievement
- Full-time low achievement
- Not enrolled
- Withdrawn for academic reasons
- Enrolled while withdrawn
- Graduated
The final display of the sequences for the cohort as whole (Figure 21) shows the ten most common sequence patterns comprising 24.4% of all the sequences. The height of the bar is proportionate to the frequency of the sequence and the $y$ axis provides the cumulative percentage. The ten most common sequences include traditional academically successful patterns ending in graduation, as well as others with disappearing pathways from the perspective of the institution. The most common sequence for the cohort is one term of full-time enrolment (4 or more courses) with low achievement (passing fewer than 4 courses), followed by non-enrolment for the remainder of the research period. Other frequent pathways include two terms full-time enrolment with low achievement and one term full-time with high achievement followed by one term low achievement, with subsequent non-enrolment for the duration of the research period. Four of the ten most frequent sequences are predominately low achievement patterns followed by non-enrolment. Students may leave because they are unsuccessful or their lack of academic success may be symptomatic of something else possibly personal, possibly related to the program or institution or perhaps related to the interplay between personal and institutional. One of the more interesting patterns is the fifth most common – two terms of full-time enrolment with high achievement and no further enrolment during the research period. These are academically successful students who choose to leave the college and not return.
Although some sequences are more common than others, the majority of the most common sequence patterns pertain to few students. Table 23 provides the fifteen most frequent sequence patterns in SPS format (State Permanence Sequence) with the state and the number of periods identified consecutively, i.e. FL/1 – N/18 is a shortened notation for full-time low achievement for 1 term, not enrolled for 18 terms. Twenty-eight percent of the cohort experienced one of these pathways. The most common pattern (51 students, 6.46%) is full-time enrolment, low achievement in fall 2006, and no further enrolment in any program at Humber. These students resemble Adelman's (2000) incidental students. The second most common sequence (27 students, 3.42%) is a traditional two-year program enrolment pattern – full-time enrolment, high achievement for two terms, no enrolment in the summer, culminating with a third term of full-time enrolment high achievement, and graduation at the end of the fourth term of enrolment. The third (2.66%) and fourth (2.53%) most common patterns are patterns of full-time enrolment and low achievement, with
no further enrolment at the college. Two of the top ten sequence patterns are one or two terms of full-time enrolment and high achievement with no further enrolment (total 3.8%) and are related to successful students who leave the college prior to program completion.

<table>
<thead>
<tr>
<th>SPS Format</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>FL/1-N/18</td>
<td>51</td>
<td>6.46</td>
</tr>
<tr>
<td>FH/2-N/1-FH/1-G/1-N/14</td>
<td>27</td>
<td>3.42</td>
</tr>
<tr>
<td>FL/2-N/17</td>
<td>21</td>
<td>2.66</td>
</tr>
<tr>
<td>FH/1-FL/1-N/17</td>
<td>20</td>
<td>2.53</td>
</tr>
<tr>
<td>FH/2-N/17</td>
<td>20</td>
<td>2.53</td>
</tr>
<tr>
<td>FH/2-N/1-FH/2-N/1-FH/1-G/1-N/11</td>
<td>15</td>
<td>1.90</td>
</tr>
<tr>
<td>FH/2-N/1-FH/2-N/1-G/1-N/12</td>
<td>11</td>
<td>1.39</td>
</tr>
<tr>
<td>FH/1-N/18</td>
<td>10</td>
<td>1.27</td>
</tr>
<tr>
<td>FH/2-N/1-FH/2-N/1-FH/2-G/1-N/10</td>
<td>10</td>
<td>1.27</td>
</tr>
<tr>
<td>FL/1-WD/2-N/16</td>
<td>8</td>
<td>1.01</td>
</tr>
<tr>
<td>FH/2-PH/1-FH/1-G/1-N/14</td>
<td>7</td>
<td>0.89</td>
</tr>
<tr>
<td>FH/2-PH/1-FH/2-PH/1-FH/1-G/1-N/11</td>
<td>7</td>
<td>0.89</td>
</tr>
<tr>
<td>FL/2-WD/2-N/15</td>
<td>6</td>
<td>0.76</td>
</tr>
<tr>
<td>FH/1-FL/1-N/1-PL/1-N/15</td>
<td>4</td>
<td>0.51</td>
</tr>
<tr>
<td>FH/2-N/1-FH/2-G/1-N/13</td>
<td>4</td>
<td>0.51</td>
</tr>
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<td>28.00</td>
</tr>
</tbody>
</table>

Each time a change occurs from one state of enrolment-achievement to another, the student experiences a transition. The number of transitions, by frequency for the whole cohort and by density for comparison of student groups so as to normalize the measure to the different populations of each group (shown below), is one measure of complexity within each sequence. Sequences with more than the expected number of transitions may indicate a more disrupted, albeit persistent, academic pathway whereas those with fewer than expected transitions may indicate a truncated pathway. A full-time student on a traditional academic pathway in a two-year program, passing all courses each term to graduation, would make four transitions between states (FH – FH – N – FH – G
A student in a three-year program in a similar situation would make six transitions between states.

Figure 22 shows the frequency of number of transitions for the cohort. As expected by the length of the programs, more than 200 cohort students experience either 4 or 6 transitions. Approximately 110 students, or more than 1 in every 8 students, make one transition from the initial enrolment – achievement state in one of more consecutive terms to not-enrolled for all subsequent terms. Many students make eight to fifteen transitions between states. These students move frequently between full-time, part-time and not enrolled and experience terms of both high and low achievement.

**Figure 22: Distribution of Number of Transitions by Number of Students (N = 790)**

The transition rates between each pair of states for the cohort as a whole, provide an estimate of probability of being in state \( j \) in time \( t \) when in state \( i \) at \( t-1 \) (Gabadinho, Ritschard, Müller, and Studer, 2011). Table 24 provides the matrix of transition rates for the dataset. The measures on the diagonal from one state to the same state (underlined) provide information on the stability of that
state. Lower numbers indicate greater instability and a higher likelihood (1 - transition rate) of leaving that state in any time period. G (graduate) has the highest instability with a transition rate of 0.01 and a probability of 0.99 of being in a different state the following term. This is to be expected as by definition state G (graduate) applies to the term in which the student graduates with a diploma or higher credential. N (not enrolled) has the lowest instability with 0.8927, which suggests that once a student leaves the institution, s/he is unlikely to return. One of the highest transition rates for most states is to not enrolled; although for all states other than G, transition rates are still less than 0.5, suggesting that on balance at the end of each term, enrolled students are more likely to return than not, a critical juncture in the institution – student relationship, where increased effort on the part of the college to maintain the relationship with the student might support the student to return. The state of PH (part-time enrolment high achievement) transitions most commonly to FH (full-time enrolment high achievement), and that of WE (enrolled while withdrawn) transitions most commonly to WD (withdrawn), suggesting that some positive and negative aspects of trajectories are self-reinforcing.

Table 24: Transition Rates Matrix

<table>
<thead>
<tr>
<th>State</th>
<th>-&gt;FH</th>
<th>-&gt;FL</th>
<th>-&gt;G</th>
<th>-&gt;N</th>
<th>-&gt;PH</th>
<th>-&gt;PL</th>
<th>-&gt;WD</th>
<th>-&gt;WE</th>
</tr>
</thead>
<tbody>
<tr>
<td>FH</td>
<td>0.4136</td>
<td>0.1174</td>
<td>0.0989</td>
<td>0.2408</td>
<td>0.0924</td>
<td>0.0370</td>
<td>0.0000</td>
<td>0.0000</td>
</tr>
<tr>
<td>FL</td>
<td>0.1065</td>
<td>0.2672</td>
<td>0.0180</td>
<td>0.4012</td>
<td>0.0430</td>
<td>0.0773</td>
<td>0.0739</td>
<td>0.0129</td>
</tr>
<tr>
<td>G</td>
<td>0.0348</td>
<td>0.0050</td>
<td>0.0100</td>
<td>0.9055</td>
<td>0.0323</td>
<td>0.0124</td>
<td>0.0000</td>
<td>0.0000</td>
</tr>
<tr>
<td>N</td>
<td>0.0525</td>
<td>0.0246</td>
<td>0.0080</td>
<td>0.8927</td>
<td>0.0113</td>
<td>0.0109</td>
<td>0.0000</td>
<td>0.0000</td>
</tr>
<tr>
<td>PH</td>
<td>0.3449</td>
<td>0.0714</td>
<td>0.1061</td>
<td>0.2224</td>
<td>0.1673</td>
<td>0.0878</td>
<td>0.0000</td>
<td>0.0000</td>
</tr>
<tr>
<td>PL</td>
<td>0.1327</td>
<td>0.1633</td>
<td>0.0561</td>
<td>0.3724</td>
<td>0.0791</td>
<td>0.1429</td>
<td>0.0434</td>
<td>0.0102</td>
</tr>
<tr>
<td>WD</td>
<td>0.0203</td>
<td>0.0508</td>
<td>0.0051</td>
<td>0.3959</td>
<td>0.0203</td>
<td>0.0203</td>
<td>0.4467</td>
<td>0.0406</td>
</tr>
<tr>
<td>WE</td>
<td>0.0000</td>
<td>0.0556</td>
<td>0.0556</td>
<td>0.1667</td>
<td>0.1111</td>
<td>0.1111</td>
<td>0.2222</td>
<td>0.2778</td>
</tr>
</tbody>
</table>

Graduate with a Diploma or Higher Credential

In this section, the patterns and diversity of pathways and transitions are explored by the individual student research-defined academic outcome of having graduated from Humber during the research
period with a two-year diploma, three-year advanced diploma, postgraduate certificate and/or bachelor degree. As expected, students who graduate with a diploma or higher credential during the research period persist for more terms of enrolment and experience more terms with high academic achievement than students who do not graduate. Figures 23 and 24 show comparatively student sequences for the two groups of students – those who graduated with a credential and those who did not – sorted by beginning term state and by end term state. Significantly more non-graduates experience low academic achievement in the first and subsequent terms, and do not persist for as many terms of enrolment as students who do graduate. Figure 24 shows that many students who do not graduate, do continue to persist even with pathways where low achievement predominates; and other students who do graduate, persist in their studies after.

Figure 25 shows the distribution of sequences for non-graduates and graduates. Approximately 50% of non-graduates have high achievement in first term compared with approximately 85% of graduates. Figure 26 provides detail of the mean times in each state (not necessarily consecutive). Compared to graduates, non-graduates spend more terms not enrolled, withdrawn for academic reasons, and experiencing low achievement both part-time and full-time.

Figure 27 shows the differences in the number of transitions by the two groups of students using density rather than frequency to normalize the count relative to the size of each group. Non-graduates generally experience fewer transitions than graduates given the large number of students, approximately 27%, who experience one transition, from initial enrolment/achievement status to not enrolled. Many students who do not complete a credential at Humber during the research period, nevertheless continue to re-enrol and transition from one enrolment-achievement state to another.
Figure 23: Individual Student Sequences by Graduate with a Diploma or Higher Credential, Sorted from Start

- Non-graduates
- Graduates
- Full-time high achievement
- Full-time low achievement
- Part-time high achievement
- Part-time low achievement
- Not enrolled
- Graduated
- Withdrawn for academic reasons
- Enrolled while withdrawn
Figure 24: Individual Student Sequences by *Graduate with a Diploma or Higher Credential*, Sorted from End

- Non-graduates
  - Full-time high achievement
  - Full-time low achievement
  - Graduated

- Graduates
  - Not enrolled
  - Part-time high achievement
  - Part-time low achievement
  - Withdrawn for academic reasons
  - Enrolled while withdrawn
Figure 25: Individual Student Sequences by Graduate with a Diploma or Higher Credential, Sorted by Distribution of Sequence States

- Non-graduates
  - Full-time high achievement
  - Full-time low achievement
  - Not enrolled
  - Graduated

- Graduates
  - Part-time high achievement
  - Part-time low achievement
  - Withdrawn for academic reasons
  - Enrolled while withdrawn
Figure 26: Mean State Times by Graduate with a Diploma or Higher Credential

Figure 27: Frequency Number of Transitions by Graduate with a Diploma or Higher Credential
Demographic Variable – Sex

Regression analysis for research-defined academic outcomes and student demographic, prior academic and college entry characteristics in Chapter 4 revealed that male students generally have more negative academic outcomes than female students. In this section, academic pathways for male and female students viewed comparatively suggest that male students generally also experience more negative pathways. Plots for sequences by sex sorted from the start (Figure 28), display similar patterns of achievement and persistence for female and male students overall, although fewer male students experience high achievement in first and subsequent terms. Sequence plots sorted by end (Figure 29) show that not only do male students have lower graduation rates, they also experience delayed graduation compared to female students. Analysis of the most frequent sequences by sex (Figure 30) shows that three of the first four most frequent sequences for male students include one or two terms of full-time enrolment with low achievement, followed by non-enrolment for the remainder of the research period. The tenth most frequent sequence for male students includes withdrawal for academic reasons. Generally, male students appear to be less successful academically and to be less likely to persist in their studies at the college. None of the top four most frequent sequences for male students include graduation whereas two of the top four most frequent sequences for female students do. Mean state times for the two groups in Figure 31 however, shows more subtle differences with female students spending more time in the higher achievement states. The number of transitions for female students (Figure 32) includes higher number of students at 4 and 6 transitions corresponding to the expected number of transitions for traditional two and three-year diploma program completion patterns, and lower numbers of students with fewer transitions. Notwithstanding these differences in patterns between male and female students, Figure 33, a scatterplot representation of the second level of multidimensional scaling shows significant overlap between them; while there are differences, the two groups are not dissimilar.
Figure 28: Sequences by Sex, Sorted from Start

<table>
<thead>
<tr>
<th>Female Students</th>
<th>Male Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>296 seq. (n=266), sorted</td>
<td>494 seq. (n=494), sorted</td>
</tr>
<tr>
<td>1 19 40 61 82 106 133 160 187 214 241 268 295</td>
<td>1 31 65 99 138 182 226 270 314 358 402 446 490</td>
</tr>
</tbody>
</table>

- **Full-time high achievement**
- **Full-time low achievement**
- **Graduated**
- **Not enrolled**
- **Part-time high achievement**
- **Part-time low achievement**
- **Withdrawn for academic reasons**
- **Enrolled while withdrawn**
Figure 29: Sequences by Sex, Sorted from End

Female Students

- Full-time high achievement
- Full-time low achievement
- Not enrolled
- Part-time high achievement
- Part-time low achievement
- Graduated

Male Students

- Withdrawn for academic reasons
- Enrolled while withdrawn

296 seq. (n=296), sorted

494 seq. (n=494), sorted
Figure 30: Most Frequent Sequences by Sex

Figure 31: Mean State Times by Sex
Figure 32: Distribution of Number of Transitions by Sex

Figure 33: Scatterplot Representation of Sequences MDS: • Female Students, ★ Male Students
College Entry Variable – Mathematics Course Placement

In Chapter 4, student algebra placement test scores at entry into first semester were positively and significantly related to all research-defined academic outcomes. To analyze sequences by group binomial variables are needed; therefore, remedial mathematics course placement is used in this section as a proxy for algebra placement test scores. Sequences are sorted into two mathematics course placement groups – remedial and program level. Figure 34, sequences sorted by initial state, shows that more students placed in a remedial mathematics course experience low achievement in first term and subsequent terms compared with students placed in the program level mathematics course. Sequences sorted by end state and mathematics course placement (Figure 35) show that proportionately fewer students placed in a remedial mathematics course graduate, and those who do demonstrate longer term persistence to graduation. The most frequent sequences for students placed in a remedial mathematics course (Figure 36) confirm the preponderance of pathways with low academic achievement, evidenced by both low achievement and withdrawal for academic reasons. In contrast, six of the ten most frequent sequences for students in the program level mathematics course include graduation with a diploma or higher credential. Figure 37, the distribution of transitions between states shows that almost twice as many remedial mathematics students (by percentage of student group) experience only one transition, likely non-enrolment after one or two terms of enrolment. Fewer remedial mathematics students experience the 4-7 transitions related to traditional patterns of enrolment and achievement for the two and three-year diploma programs. Remedial mathematics course placement appears to predicate less academically successful pathways for many students, although not for all.
Figure 34: Sequences Sorted from Start by Mathematics Course Placement

- Full-time high achievement
- Full-time low achievement
- Not enrolled
- Part-time high achievement
- Graduated
- Part-time low achievement
- Withdrawn for academic reasons
- Enrolled while withdrawn
Figure 35: Sequences Sorted from End by Mathematics Course Placement

446 seq. (n=446), sorted

Program Math Placement

344 seq. (n=344), sorted

Remedial Math Placement

- Full-time high achievement
- Full-time low achievement
- Not enrolled
- Part-time high achievement
- Graduated
- Part-time low achievement
- Withdrawn for academic reasons
- Enrolled while withdrawn
Figure 36: Most Frequent Sequences by Mathematics Course Placement

Program Math Placement

Remedial Math Placement

Cum. % freq. (n=446)

25.3%
0%

F06 F07 F08 F09 F10 F11 F12

25.9%
0%

F06 F07 F08 F09 F10 F11 F12

Full-time high achievement
Full-time low achievement
Not enrolled
Part-time high achievement
Part-time low achievement
Graduated
Withdrawn for academic reasons
Enrolled while withdrawn

Figure 37: Number of Transitions by Mathematics Placement

Program Math Placement

Remedial Math Placement

Density

0.20
0.15
0.10
0.05
0.00

0 5 10 15

Density

0.20
0.15
0.10
0.05
0.00

0 5 10 15
College Entry Variable – Applied by July 1, 2006

The Chapter 4 regression analysis of research-defined academic outcomes with student demographic, prior academic and college entry characteristic covariates reveals that application for fall entry prior to July 1st, 2006, shortly after the tuition due date in late June, is significantly related to total courses passed, course completion rate and graduate with a diploma or higher credential. A large majority of students apply by July 1st for fall entry; 611 as compared to 179 who apply later. Sequence analysis of student academic pathways for these two groups of students sorted by start (Figure 38) shows that more students who applied by July 1, 2006 experience high academic achievement in first and subsequent terms compared with students who applied after July 1, 2006. Greater numbers of earlier applicants also display greater persistence and higher graduation levels as shown by Figure 39. The most frequent sequences for these students, Figure 40, confirms that graduation with a diploma or higher credential by fall 2009 is much more common for the earlier applicants than for the later applicants. The most common sequence for both groups of applicants is one term of low achievement followed by non-enrolment for 18 terms; however, it is experienced by a much larger percentage of the later applicant group than the early applicant group. Analysis of between-state-transitions (Figure 41) shows that almost 19% of the later applicant group experiences one transition compared with approximately 12.5% of the earlier applicant group; however, differences between the two groups of students with regard to the percentage with 4-7 transitions, the expected number for completion of two-year and three-year programs are not as large.
Figure 38: Sequences Sorted From Start by Application Date

- Applied after July 1, 2006
- Applied by July 1, 2006
- Full-time high achievement
- Full-time low achievement
- Part-time high achievement
- Part-time low achievement
- Not enrolled
- Graduated
- Withdrawn for academic reasons
- Enrolled while withdrawn
Figure 39: Sequences Sorted from End by Application Date

- Full-time high achievement
- Full-time low achievement
- Not enrolled
- Part-time high achievement
- Part-time low achievement
- Graduated
- Withdrawn for academic reasons
- Enrolled while withdrawn
Figure 40: Most Frequent Sequences by Application Date

- Applied after July 1, 2006
  - Full-time high achievement
  - Full-time low achievement
  - Not enrolled
  - Graduated
  - Part-time high achievement
  - Part-time low achievement
  - Withdrawn for academic reasons
  - Enrolled while withdrawn

Figure 41: Number of Transitions by Application Date

- Applied after July 1, 2006
  - Density

- Applied by July 1, 2006
  - Density
College Entry Variable – Transfer Credit(s)

Regression analysis of academic outcomes with student demographic, prior academic and college entry characteristics in Chapter 4 showed that having one or more transfer credits was related to higher course completion rates and graduating with a diploma or higher credential. Approximately 9% of the students in the fall 2006 cohort received one or more exemptions from program courses based on transfer credit from prior successful postsecondary course completion or achieving a high score on the English placement test. Sequence analysis permits comparison of the academic pathways of this group of students to the academic pathways of the students without transfer credit(s). Figure 42 displays the transversal state distributions of sequences for these two groups. Almost 80% of the students who received transfer credit had high achievement in first term and numbers appear to decrease in subsequent terms at a lower rate than for students without transfer credits. Students with transfer credits also had noticeably early and high graduation rates. Higher graduation rates are also seen in the most frequent sequences for the group (Figure 43). The top five most common sequences display patterns of full-time enrolment and high achievement leading to graduation, and the third most common sequence includes a term of part-time study with high achievement post-graduation. These patterns are reflected in the number of transitions made by students (Figure 44). More than 20% of students experience 4 transitions and another almost 15% experience 6 and 7 transitions. Fewer students with transfer credits than without transfer credits experience very low or very high numbers of transitions. Students who arrive at Humber with transfer credits from another postsecondary institution, are perceived by that institution as having dropped out prior to completion of a credential; a perverse characterization when it can be seen that generally these students are among the most successful students in the 2006 cohort. This suggests that many students will be successful academically when they are enrolled in a program and/or institution which fits with their interests at a time when they are able to invest the necessary resources to be successful.
Figure 42: Transversal State Distribution by Transfer Credit(s)

Figure 43: Most Frequent Sequences by Transfer Credit(s)
Summary of Sequence Analysis Descriptive Findings

The descriptive analysis of the academic achievement pathway sequences, for the cohort as a whole, by research-defined academic outcome of graduate with a diploma or higher credential, and by student group, demonstrates that PSE academic pathways are diverse. In response to research Question 3: In what ways, if any, do the academic pathways, represented by longitudinal patterns of enrolment and achievement, of students who persist in their studies in programs at Humber College differ from those who do not persist?, sequence analysis reveals that there are no uniform ways in which persistence pathways differ from pathways of non-persistence. Exploration of academic pathway by student group reveals differences between groups in academic pathway and persistence as well as commonalities within groups. With 525 unique sequences for 790 students, this is not surprising.
Different student groups identified by demographic characteristic (sex) and by college entry characteristic (remedial mathematics placement, applied by July 1st, and having one or more transfer credit(s)) appear to experience differences in their pathways as displayed by beginning enrolment-achievement patterns and ending enrolment-achievement patterns including *graduation with a diploma or higher credential*, the amount of time spent in the different enrolment-achievement states, and the number of transitions experienced by students moving between different states. None of the patterns identified contradict the conclusions in the regression analysis of relationships between characteristics and the research-defined academic outcomes in the previous chapter. Male sex and placement in remedial mathematics, a proxy for algebra placement test scores, appear associated with shorter and less academically successful pathways. Having applied by July 1st and having one or more transfer credit(s) appear associated with more academically successful pathways.

**Analytical Findings – Optimal Matching with Cluster Analysis, and Discrepancy Analysis**

**Optimal Matching with Cluster Analysis**

The purpose of cluster analysis of the sequences is to identify typical or representative sequences for each cluster. Typical sequences can then be used with regression to explore relationships between the representative sequences and student demographic, prior academic and college entry characteristics. Optimal matching is the first step to using cluster analysis to identify typical sequences within the dataset. As detailed in Chapter 3, optimal matching is a process to measure the (dis)similarities between pairs of sequences; in this study, using a substitution cost matrix based on the transition rates between states detailed above. Optimal matching is the minimum cost of transforming one sequence into another and therefore the resulting distance matrix is symmetrical. A portion of the $790 \times 790$ distance matrix is shown in Chapter 3 (Table 5).
Cluster analysis involves the identification of homogenous or typical sequences representative of a group of sequences. Hierarchical agglomerative clustering successively builds clusters by grouping individual sequences which are close together based on the distance matrix until all observations are part of a single group. Hierarchical clustering based on Ward's algorithm groups items based on the increase in variance within each cluster as a measure of the distance between the clusters. The result is a tree-type structure, called a dendrogram, where the clusters can be visualized (Figure 45).

As described in Chapter 3, both hierarchical clustering using Ward's algorithm and using partitioning around medoids were tested. Four clusters using the hierarchical methodology appeared to produce the best result and are highlighted in red in Figure 45. At any point, the decision on the number of clusters ignores the distinction between groups at lower levels of agglomeration.

Figure 45: Dendogram of Hierarchical Clustering, Ward's Algorithm, Four Cluster ($\Pi$) Solution

Agglomerative Coefficient = 0.98
Figure 46 displays the four cluster grouping sorted by distance to the most frequent sequence in each cluster. The labels attached to each of the clusters reflect the dominate sequence patterns within each cluster. The first cluster, Early Leavers – Low Achievement is comprised of 308 sequences with 150 distinct sequences, most of which begin with full-time enrolment low achievement in fall 2006. The most frequent sequence appears 51 times. Relatively few sequences in this cluster display persistence beyond the first two terms. The second cluster, Two-year + Grads is comprised of 141 sequences, with 83 distinct sequences and the most frequent sequence appearing 27 times. Most sequences display full-time high achievement across two terms in each of the first two academic years, and many graduate in winter 2008. The third cluster, Three-year + Grads, with 208 sequences in total and 160 distinct sequences, displays a similar pattern across three academic years. The most frequent sequence in this cluster appears 15 times. Clusters 2 and 3, Two-year + Grads and Three-year + Grads, appear most similar to traditional two and three-year diploma program patterns of enrolment, achievement and graduation. The fourth cluster, Longer-TermPersisters, with 133 sequences, 132 distinct sequences and the most frequent sequence appearing twice, displays the most diversity, with varied high and low achievement across most of the 19 terms of the research period, and no dominate pattern relating to graduation. One apparent trend across the 4 clusters is that as persistence lengthens similarity between sequences decreases. The longer students persist in their studies, the more diverse the pathways appear to become, which suggests that as students become older, they modify their PSE enrolment as needed to balance with their responsibilities in other life spheres. Low achievement in many cases could reflect the challenges in doing this. Figure 47, sorted by end state, highlights the different persistence patterns within each cluster as well as the dominant pattern of timing of graduation. The transversal state distribution in Figure 48, shows similarities between sets of clusters – 1 and 4, Early Leavers-Low Achievement and Longer-term Persisters, and 2 and 3, Two-year + Grads and Three-year + Grads – differentiated primarily by degree of persistence.
Figure 46: Four Cluster Solution Sorted by Distance to Most Frequent Sequence

**Early Leavers – Low Achievement**

- Full-time high achievement
- Full-time low achievement
- Graduated

**Two-year + Grads**

- Not enrolled
- Part-time high achievement
- Enrolled while withdrawn

**Three-year + Grads**

- Withdrew for academic reasons
- Part-time low achievement

**Longer-term Persisters**

- Not enrolled
- Part-time low achievement
Figure 47: Four Cluster Solution Sorted from End State

**Early Leavers – Low Achievement**

- Full-time high achievement
- Full-time low achievement
- Not enrolled
- Graduated

**Two-year + Grads**

- Not enrolled
- Withdrawn for academic reasons
- Enrolled while withdrawn

**Three-year + Grads**

**Longer-term Persisters**
Figure 48: Transversal Distributions for Four Cluster Group

Figure 49 displays the most frequent sequences in each of the clusters. The ten most frequent sequences provide varying and decreasing levels of coverage for each cluster: 48.1% of Early Leavers-Low Achievement, 45.4% of Two-year + Grads, 24% of Three-year + Grads and 8.3% of Longer-term Persisters.

Clustering the sequences reveals common patterns within the cohort while emphasizing the diversity of pathways even within each cluster.
Logistic Regression with Demographic, Prior Academic and College Entry Variables

Generally, as described in Chapter 3, the next step is to analyse the relationships between the independent demographic, prior academic and college entry variables and the dependent clusters with logistic regression. Table 25 provides details of the regression output including the exponent of the regression coefficients, the odds ratios, and the level of significance. Male students and students who are placed in remedial mathematics in first term are more likely than female students and those
placed in program level mathematics to be in the Early Leavers - Low Achievement group, and less likely than female students and those placed in program level mathematics to be in the Two-year + Grad group. Remedial mathematics students are also less likely than program level mathematics students to be in the Three-year + Grad group. Students who are age 17-18 in fall 2006 are less likely than older students to be in the Early Leavers - Low Achievement group or the Longer-term Persisters group, and more likely to be in the Three-year + Grad group. Those with transfer credits from prior PSE are less likely to be in the Early Leavers - Low Achievement group and more likely to be in the Two-year + Grad group. Students who took grade 12 college English are also more likely to be in the Early Leavers – Low Achievement group and less likely to be in the Longer Term Persisters cluster, and students who took Grade 12 college mathematics were 2.6 times as likely to be in the Longer-term Persisters group than the other groups; however results regarding high school course stream must be interpreted as unreliable for the reasons previously noted.
Table 25: Odds Ratios for Cluster Membership (N = 790)

<table>
<thead>
<tr>
<th></th>
<th>Early Leavers</th>
<th>Two-year + Grads</th>
<th>Three-year + Grads</th>
<th>Longer-term Persisters</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Odds Ratio</td>
<td>Significance</td>
<td>p</td>
<td>Odds Ratio</td>
</tr>
<tr>
<td>(constant)</td>
<td>0.440</td>
<td>0.000</td>
<td>***</td>
<td>0.317</td>
</tr>
<tr>
<td>Sex Male</td>
<td>2.011</td>
<td>0.000</td>
<td>***</td>
<td>0.656</td>
</tr>
<tr>
<td>Age 17-18</td>
<td>0.619</td>
<td>0.008</td>
<td>**</td>
<td>1.183</td>
</tr>
<tr>
<td>Remedial Mathematics</td>
<td>1.707</td>
<td>0.001</td>
<td>***</td>
<td>0.557</td>
</tr>
<tr>
<td>Grade 12 College English</td>
<td>2.808</td>
<td>0.009</td>
<td>**</td>
<td>1.676</td>
</tr>
<tr>
<td>Grade 12 College Mathematics</td>
<td>0.982</td>
<td>0.962</td>
<td></td>
<td>0.304</td>
</tr>
<tr>
<td>Grade 9 Applied English</td>
<td>0.960</td>
<td>0.941</td>
<td></td>
<td>0.000</td>
</tr>
<tr>
<td>Grade 9 Applied Mathematics</td>
<td>0.790</td>
<td>0.681</td>
<td></td>
<td>1.168</td>
</tr>
<tr>
<td>Applied by July 1, 2006</td>
<td>0.734</td>
<td>0.090</td>
<td></td>
<td>1.081</td>
</tr>
<tr>
<td>Transfer Credit(s)</td>
<td>0.436</td>
<td>0.008</td>
<td>**</td>
<td>2.363</td>
</tr>
</tbody>
</table>

*p<.05.  **p<.01.  ***p<.001
Cluster Quality

Many of the studies included in Chapter 3 as exemplars of the use of sequence analysis in the social sciences conclude with either the descriptive analysis of sequences, or at this point, with the results of logistic regression with independent variables and the dependent sequence clusters (for example, Fuller & Martin, 2012). This research study extends the analysis by first examining the quality measures of the four-cluster solution and second, by utilizing discrepancy analysis to explore relationships between the independent covariates and the dissimilarities between individual sequences. For a detailed discussion, see Studer (2013) and Studer et al. (2011).

Clustering simplifies the data. By focussing on homogeneity within clusters, it disregards heterogeneity. It also disregards homogeneity between clusters. Regardless of the number of clusters, clustering combines differences in sequences which may or may not be relevant to analysis (Studer, 2013). As described in Chapter 3, several methods of clustering the sequences were tested prior to settling on the four cluster solution based on hierarchical agglomerative clustering with Ward's algorithm, which provided the best fit solution. The quality measure for the final solution, average silhouette width, explained in Chapter 3, is presented in Table 26. The average silhouette width (ASW) has a range from -1 to 1 (Rousseeuw, 1987; Studer, 2013). A high ASW indicates differences between the groups and strong homogeneity within the groups. A low ASW indicates that the groups are not well differentiated or there is weak homogeneity within each group. In general, an ASW less than .50 indicates the structure of the cluster is weak; an ASW ≤ 0.25 indicates there is no underlying structure to the cluster (Rousseeuw, 1987; Studer, 2013). Based on this measure of cluster quality, three of the clusters have weak structure – Early Leavers - Low Achievement, Two-year + Grads, and Three-year + Grads, and the fourth cluster, Longer-term Persisters has no underlying structure.
Table 26: Average Silhouette Widths (ASW) for Clusters

<table>
<thead>
<tr>
<th>Cluster</th>
<th>ASW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early Leavers - Low Achievement</td>
<td>0.333</td>
</tr>
<tr>
<td>Two-year + Grads</td>
<td>0.368</td>
</tr>
<tr>
<td>Three-year + Grads</td>
<td>0.260</td>
</tr>
<tr>
<td>Longer-term Persisters</td>
<td>-0.134</td>
</tr>
</tbody>
</table>

Multidimensional scaling permits scatterplot visualization of the different cluster groups. One dot could represent more than one sequence so the plot does not show density. The scatterplot in Figure 50 reveals noticeable overlap, or non-differentiation, between the four clusters. The green cluster, representing the 4th cluster, Longer-term Persisters, is the most highly disseminated.

Figure 50: Scatterplot of Multi-Dimensional Scaling Four Cluster Solution: ● Early Leavers-Low Achievement, ○ Two-year + Grads, ● Three-year + Grads, □ Longer-term Persisters
Although logistic regression with demographic, prior academic and college entry covariates showed significant relationships with the cluster membership, individual clusters are not clearly differentiated from the other clusters. The sequence plots of the clusters and the coverage of the most frequent cluster sequences show that there is a lack of homogeneity within each cluster. The Average Silhouette Widths reveal that three of the four clusters have weak structures and the fourth has no structure. The underlying assumptions of cluster analysis are therefore not met. There are not readily identifiable typical sequences to represent the diverse academic pathways within each cluster and the regression analysis therefore cannot be relied upon regarding relationships with typical cluster sequences.

**Discrepancy Analysis**

Discrepancy analysis provides an alternate technique to cluster analysis for exploring relationships between student academic pathways represented by sequences of achievement and enrolment states and demographic, prior academic and college entry characteristics, supporting a response to research Question 4: *In what ways, if any, do the demographic, prior academic, or college entry characteristics of students at Humber College appear related to student academic pathways?*

The differences in academic pathways and outcomes between individual students can be interpreted in several ways – from the perspective of students at risk of failure or from the perspective of students exercising agency regarding the many choices in educational and job opportunities they are offered. Discrepancy analysis attempts to both highlight the effect of structures on trajectories while allowing for individual agency within those structures (Studer et al., 2011).

As previously described in Chapter 3, discrepancy analysis (Studer et al., 2011) of a set of sequences circumvents the inherent weaknesses of cluster analysis by examining the relationship between the dissimilarities of sequences for individual students and the demographic, prior academic
and college entry covariates. With discrepancy analysis, there is no need to cluster the sequences and identify typical sequences or pathways; instead, the relationship between sequences and covariates is analyzed directly. In essence, discrepancy analysis relies on a generalization of the principles of ANOVA, using a pseudo-$R^2$ and a pseudo-$F$ test to measure the significance of the association between the covariates and the pairwise dissimilarities of individual sequences from optimal matching. Table 27 provides the results of discrepancy analysis of the demographic, prior academic and college entry covariates for the full model and for the model resulting from backward, stepwise deletion of the insignificant covariates. The full model with four insignificant covariates explains slightly more of the discrepancy ($R^2 = 3.4\%$) than the most parsimonious model ($R^2 = 2.7\%$).

In response to Question 4: *In what ways, if any, do the demographic, prior academic, or college entry characteristics of students at Humber College appear related to student academic pathways?*, covariates with a significant relationship to the differences in academic pathways as represented by the individual sequences include sex, arithmetic and algebra mathematics placement test scores, application by July, 2006, and having transfer credits. These results are similar to the Chapter 4 findings related to logistic and linear regression of research-defined academic outcomes with the student characteristic covariates. The results of the backward model generally reflect those of the full model. Insignificant factors include birthplace, age, remedial English and mathematics placement in first semester of college, and ESL placement. Results pertaining to the relationship of grade 9 and 12 mathematics and English course stream with pathway dissimilarities cannot be relied upon, as previously discussed.
Table 27: Discrepancy Analysis Explanatory Factors (N = 790)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Full Model</th>
<th>Backward Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$F_v$</td>
<td>$\Delta R^2$</td>
</tr>
<tr>
<td>Male sex</td>
<td>4.179</td>
<td>0.005</td>
</tr>
<tr>
<td>Birthplace Canada</td>
<td>0.934</td>
<td>0.001</td>
</tr>
<tr>
<td>Age in 2006</td>
<td>1.523</td>
<td>0.002</td>
</tr>
<tr>
<td>Grade 9 applied English</td>
<td>0.856</td>
<td>0.001</td>
</tr>
<tr>
<td>Grade 12 college English</td>
<td>2.091</td>
<td>0.003</td>
</tr>
<tr>
<td>Remedial English placement</td>
<td>1.245</td>
<td>0.002</td>
</tr>
<tr>
<td>ESL placement</td>
<td>0.796</td>
<td>0.001</td>
</tr>
<tr>
<td>Grade 9 applied Math</td>
<td>0.880</td>
<td>0.001</td>
</tr>
<tr>
<td>Grade 12 college Math</td>
<td>2.031</td>
<td>0.003</td>
</tr>
<tr>
<td>Arithmetic score</td>
<td>1.667</td>
<td>0.002</td>
</tr>
<tr>
<td>Algebra score</td>
<td>4.892</td>
<td>0.006</td>
</tr>
<tr>
<td>Remedial math placement</td>
<td>0.867</td>
<td>0.001</td>
</tr>
<tr>
<td>Applied by July 1, 2006</td>
<td>2.372</td>
<td>0.003</td>
</tr>
<tr>
<td>Transfer credit(s)</td>
<td>2.367</td>
<td>0.003</td>
</tr>
<tr>
<td>Total</td>
<td>2.391</td>
<td>0.041</td>
</tr>
</tbody>
</table>

Summary

This chapter provides a description of student enrolment and achievement patterns for the 2006 cohort and an analysis of the relationship between the independent variables and the sequence pathways as dependent variables to respond to the final two research questions, Question 3: *In what ways, if any, do the academic pathways, represented by longitudinal patterns of enrolment and achievement, of students who persist in their studies in programs at Humber College differ from those who do not persist?*, and Question 4: *In what ways, if any, do the demographic, prior academic, or college entry characteristics of students at Humber College appear related to student academic pathways?*

The detailed holistic exploration of individual student postsecondary pathways through sequence analysis of individual student enrolment and achievement patterns clearly demonstrates that students
have diverse academic experiences and make varied choices regarding course and program enrolment. Students demonstrate agency in moving between part-time enrolment, full-time enrolment and non-enrolment, as well as for some, continuing to enrol in courses while withdrawn for academic reasons. In response to Question 3, the descriptive analysis of sequence pathways reveals little uniformity in pathways for those students who persist or for those who do not persist. While many students leave Humber after one or two terms of disparate achievement, others persist for many terms while also experiencing varied academic success, including for some, completion of multiple credentials. Longer term persistence is characterized by increasingly unique sequences.

Pathway patterns were explored by beginning enrolment-achievement, ending enrolment-achievement, time spent in varied enrolment-achievement states, and how frequently students transition between different enrolment-achievement states. Generally, students follow individualized academic pathways with 525 unique pathways over 19 terms for the 790 cohort students. Pathway patterns reveal that students who do not graduate with a diploma or higher credential, generally experience more low achievement than students who do graduate with a diploma or higher credential. This is not surprising and indicates that academic achievement is one indicator of the possible alignment between individual student aspiration and resources.

With regard to Question 4, differences in pathway patterns are observable both within and between student groups identified by sex, remedial mathematics placement, having applied by July 1st, and having one or more transfer credits from prior PSE. Pathway patterns confirm the results of the analysis of academic outcomes summarized in Chapter 4. Male students and those placed in remedial mathematics in first term based on the mathematics placement test scores generally experience less successful pathways whereas students who apply earlier and those with transfer credits generally experience more successful pathways.
Optimal matching with cluster analysis appears to discriminate four sequence clusters within the dataset from which typical sequences might be identified. An evaluation of odds ratios for cluster membership identified significant covariates for each of the four clusters. Average silhouette width, a measure of cluster quality; however, highlighted that three of the clusters had a weak structure and the fourth had no structure indicating the clusters are poorly differentiated with overlap between the sequences assigned to each cluster suggesting there are no typical clusters within the dataset.

Discrepancy analysis of student demographic, prior academic, and college entry characteristics with the dissimilarities of the individual student pathway sequences identified significant relationships with male sex, arithmetic placement test score, algebra placement test score, having applied by July 1, 2006 and having transfer credits from prior PSE. Having been enrolled in a grade 9 applied mathematics course is also identified as a significant predictor; however, as with the results relating to the other high school course streams, this finding may not be reliable. As is found with the academic outcomes, both the individual and cumulative explanatory effects of these covariates are quite small, and unlikely to be of practical use as early indicators of students who might not persist or who might be on a more prolonged and disordered pathway.

Analytical findings related to PSE academic outcomes and pathways suggest that many students enter Humber academically underprepared, particularly in mathematics, and many are uncertain of their direction. Some students are academically successful regardless of these and other personal challenges; others are not. College systems, policies and processes may be supportive, neutral or challenging for students; it is the effect on individual student academic outcomes and pathways which determines their nature. To the extent these are flexible so academically successful PSE participation aligns with other student responsibilities and challenges, systems, policies and processes are supportive. The methodology of sequence analysis permits the visualization of pathways enabling the identification of enrolment terms where there appears to be a lack of
alignment between student aspiration, evidenced by enrolment status (full-time or part-time) and student achievement, evidenced by low achievement (defined relative to enrolment status).

Systems, policies and processes which may contribute to the lack of alignment can be found at the government policy level, the K-12 level and the level of the individual PSE institution. Postsecondary student financial assistance is provided and regulated by the federal and provincial governments, including regarding eligibility requirements by institution, program and student course load. Provincial government direct funding to the public PSE institutions also differentiates between part-time and full-time students and remedial and program level courses. Full-time students and program level courses are prioritized and receive more proportionately. Government policy also influences institutional tuition fee policy, and currently continues to support the flat fee tuition structure for full-time college students who are taking a reduced course load.

At the K-12 level, policies and processes regarding teaching of mathematics may to be relevant. These include the grade level where specialist mathematics teachers are required for teaching mathematics, and the skill mastery a student must demonstrate to progress to the next grade and/or to graduate. Policies and processes regarding the streaming of students into applied courses in early high school, and whether or not schools are required to offer bridging opportunities for students in applied courses to move back into academic courses in later grades may also be relevant factors.

At Humber, possible barriers include those related to program curriculum and prerequisite structure, flat-fee tuition structure, how students are identified for remedial mathematics course placement, and to the distinction between full and part-time enrolment status.
Chapter Six: Analysis, Recommendations, and Conclusions

This study was an exploratory analysis of the academic outcomes and pathways for one cohort of general business diploma students at one college in the GTA informed by a life course perspective. The purpose of the research was to describe differences in academic achievement and in enrolment and achievement pathways for students who persist in PSE and for those who do not, and to explore relationships between academic outcomes and pathways and demographic, prior academic and college entry characteristics.

The study was guided by four research questions. In response to Question 1: *In what ways, if any, does student academic achievement, represented by course and credential completion, and student persistence, represented by course enrolment, at Humber College differ from the policy-mandated, reported graduation rate?*, analysis of the research-defined academic outcomes shows that the graduation rate metric underreports credential completion due to the time censored period for completion and the credentials excluded from the calculation by policy. The prioritization of graduation within 200% of the program length also masks significant course completion by non-graduates, and details regarding persistence for all students as shown by course enrolment counts.

Question 2 asks *in what ways, if any, do the demographic, prior academic, or college entry characteristics of students at Humber College appear related to student academic achievement and persistence?* Findings from logistic and linear regression of the research-defined academic outcomes of *graduate with a diploma and higher credential, total courses enrolled, total courses passed* and *course completion rate* with the independent variables identify several covariates significantly related to academic achievement and persistence; however, both the individual and cumulative effect sizes are small. Being male is negatively related to all of the research-defined academic outcomes at a significance level of *p*<.001 and algebra placement test scores are positively related to all four measures at a significance level of *p*<.001. Several of these outcomes are
positively associated with having applied by July 1, 2006 and having transfer credits from prior PSE. Two outcomes, *total courses enrolled* and *total courses passed*, are negatively associated with age ($p < .05$).

Regarding research Question 3: In what ways, if any, do the academic pathways, represented by longitudinal patterns of enrolment and achievement, of students who persist in their studies in programs at Humber College differ from those who do not persist?, sequence analysis findings identify commonalities among pathways of students who persist at Humber for only one or two terms. As persistence increases, pathway patterns become more diverse and unique; however, both short and long term persisters experience diverse terms of enrolment and achievement patterns.

In response to Question 4: In what ways, if any, do the demographic, prior academic, or college entry characteristics of students at Humber College appear related to student academic pathways?, regression results show the significant predictors of academic achievement outcomes and persistence discussed above regarding Question 2, not including age, are also significant predictors for dissimilarities in academic pathway. This is not unexpected, as academic outcomes are disaggregated data which comprise the enrolment-achievement statuses within the sequence pathways. As with the covariates of academic outcomes and persistence, the individual and cumulative effect sizes are too small to assist with differentiating students from a practical perspective.

Results suggest that mathematics skills demonstrated by many students upon college entry appear insufficient for academic success in the general business diploma programs although a senior high school mathematics course credit is required for both high school graduation and program admission. Early high school streaming may also be a related barrier. At the postsecondary level institutional full-time flat fee tuition structure alone and coupled with financial aid eligibility rules, policies which
encourage students to enrol in a full course load regardless of other responsibilities, may affect student success.

As discussed below, cultural aspects of the system in its entirety may also affect academic success for some students. Educational success appears highly gendered and the at risk discourse which labels students as being at risk of failure based on demographic, socio-economic or other characteristic situates success, or lack thereof, at the level of the individual student without consideration of institutional and/or systems factors.

Central Findings

The research findings relate to the specific context of the fall 2006 cohort and are not to be considered as having general applicability for postsecondary students in other cohorts or other institutions, although the research design and methodology might be seen as transferable to other contexts. These findings provide only a partial picture of student outcomes and pathways within one institution. Missing are the students’ stories regarding their mapped pathways of enrolment and achievement; narratives about their PSE goals and experiences, the decisions they made and why, and what supported and/or impeded their successful participation. The results do not touch on their motivation to participate in PSE, their level of engagement with learning, how satisfied with their experience they are, or what aspects of their experience they value the most. Tracking and mapping data points misses the meaning behind the patterns. An individual student’s educational success, however broadly or narrowly construed, is a complex outcome influenced by many factors related to historical and geographical social and economic location; family, community and institutional relationships, prior experiences and trajectories, and individual attributes including agency. The independent variables explored in this study are only proxies for facets of this complexity. Variation in outcomes and pathways may relate to unknown and unexplored factors. Despite these limitations, the analysis identifies common themes and implications for policy.
Academic Outcomes, Pathways and Persistence are Diverse

Descriptive and analytical findings demonstrate that cohort students experience diverse academic outcomes, pathways and persistence. This diversity suggests that, pursuant to its position in the Ontario PSE system and its mandate of providing opportunities to students who are underrepresented in PSE, Humber's general business diploma programs provide access to PSE, including pathways to other fields of study and other credentials, for a diverse group of students across numerous parameters.

The study identifies 525 unique sequences for 790 students over 19 terms, with increasing pattern diversity apparent with longer-term persistence, revealing that just as pathways to PSE are diverse (Bayard & Greenlee, 2008; Colleges Ontario, 2005; King et al., 2009), so too are pathways within PSE in both the short term and the long term. Andres and Offerhaus (2013) found 540 sequences for 540 participants transitioning in and out of PSE over 22 years, also suggesting the longer the time period, the more diverse the sequences.

Tinto (1975), Bean (1980), Bean and Metzner (1985) and Metzner and Bean (1987), and Dietsche (1990) conceptualized dropout as a unidirectional, one-time event; and for many students at the level of a single institution, dropping out is a unidirectional one-time event; the most frequent patterns of enrolment-achievement for the student cohort support this. For many students, however, enrolment behaviour demonstrates a more fluid pattern. Transition rates between sequence states, an indication of student pathway stability, show that a significant number of students transition frequently between full time, part time and not enrolled, likely in response to resource demands outside of education and academic demands. This behaviour suggests more permeable boundaries between the PSE institution and other facets of student lives, conceptualized by Trow (1973) as part of a universal higher education system, and supported by the institutional technology of learning management systems and online courses. Interpersonal technology of smart phones and social
media enable student engagement simultaneously with PSE and with external social and work orientations on a constant 24/7 basis.

The mapping of sequence pathways demonstrates that the assumption of a linear and continuous pathway in the historical models does not reflect the enrolment behaviour of the majority of cohort. In a time of lifetime learning, with increasingly flexible educational options, the ongoing relevance of these frameworks is questionable. Part-time enrolment and non-continuation of enrolment with future return to study are common and in fact, should be expected and supported rather than pathologized through the language of deficit and abnormality, necessitating intervention. Tinto's model, relating student academic and social integration to goal and institutional commitment and persistence also does not appear to effectively describe the academic pathways identified in this study. If persistence, in the form of re-enrolment over time, is evidence of academic and social integration, how do we explain part-time, low achieving students who do not appear well integrated into the college community who continue to re-enrol? I do not proffer an alternate theoretical model. As this research is an exploratory study with a small student group, it would be premature to do so with such a limited context and sample.

At the institutional level, research findings confirm that leaving is highest in first year of enrolment (Finnie & Qui, 2008a, 2008b); female students experience higher levels of persistence (Finnie & Qui, 2008b; Finnie et al., 2012); persistence is higher for younger students (Finnie & Qui, 2008b); and male students are more likely to leave (Ma & Frempong, 2008; Shaikenks & Gluszynski, 2007).

Previous research identifies relationships between PSE persistence and both high school grades (Martinello, 2008; Shaikenks et al., 2008; Kamanzi et al., 2009) and postsecondary grades (Finnie & Qui, 2008b; Ma & Frempong, 2008). The current study did not explore the relationship of high school grades and persistence. Postsecondary grades were utilized in the research analysis indirectly through achievement status in the sequence coding. Relationships with postsecondary grades may
be seen in the calculated transition rates between states derived from the data where some positive and negative aspects of enrolment-achievement states appeared to be self-reinforcing over time.

The findings challenge the concept of persistence as either enrolled or not, consistent with Hagedorn (2006), as some students clearly move in and out of PSE over time. The research-defined academic outcome measure total courses enrolled identified a large number of students who could be classified as incidental (Adelman, 2000) based on their limited engagement at the course level, whereas other students persist even while failing and/or dropping, and then repeating courses. The findings also highlight that some students persist beyond a single program or credential. Postsecondary persistence therefore encompasses a range of enrolment behaviours, foregrounding the role of student agency in PSE pathways suggesting that the traditional model of full-time enrolment in fall and winter terms with summers off for the delivery of most programs primarily reflects the historical structure of PSE and the needs of the institution and system rather than the needs or desires of many students. When offered flexible options, many students engage with PSE differently, making choices on a term-by-term basis. It must be noted, differentiated program delivery creates significant institutional challenges related to management of enrolment, scheduling, hiring and funding.

The research perspective is informed by the literature on education as part of the life course. Both in the transition to PSE (Côté & Bynner, 2008; Elder, 1994, 1998) and within PSE (Côté & Levine, 1997; Heinz, 1999; Martell, 2011) this study provides evidence that the timing, duration and outcomes of a transition may reflect structures, institutions and individual behaviour from prior transitions and life stages. It also provides evidence of the individual exercise of agency by students, as demonstrated by the choices made by students regarding the timing of their college application before entry, initial program of entry and final program of enrolment, and enrolment behaviour while at Humber.

Results also support that early trajectories are not determinate of later trajectories (Laub & Sampson, 2003); that the transition into PSE has the potential to alter prior trajectories (Mayer, 2009; Thiessen,
2007). Academic underpreparedness as evidenced by algebra score and mathematics and English placement test results does not determine PSE outcome or pathway, nor do sex, age, high school course stream, or first term college performance. Visually, there are differences in patterns of enrolment and achievement between students who were, for example, placed in remedial mathematics and those placed in the program level mathematics course; however, the results of regression showed that where significant, the effect size is small, providing a strong counter-argument against the pervasiveness of the at risk discourse regarding student PSE success. Past and current trajectories and life circumstances do not determine individual potential and future possibilities.

**Student Group Membership is of Limited Value**

The variation found in individual student academic pathways and outcomes does not appear to be related to specific groups of students identified by demographic, prior academic, and college entry characteristic, suggesting these groups are not homogeneous. Institutionally available student group level data appear to be insufficient to predict differentiated pathways and outcomes. These results provide support for the most recent findings of Finnie et al. (2012) that group level membership is a "blunt policy tool" for delivering student support within the institution (p. 49). Although Finnie et al. (2012) suggest that both high school and PSE grades together with direct investigation of the individual student experience including through surveys should guide support strategies, the current findings suggest that such academic measures would identify only some of the students who might be facing a more complex pathway within the institution or within PSE more generally, and perhaps more weight should be placed on direct interaction with individual students.

Notwithstanding this caveat, from a systems perspective we cannot ignore the differentiated patterns for male students as compared to female students. There is a high proportion of male students in the research cohort and a higher proportion of males than expected enrolled in the two-year Business
Management program, the shortest, most generic program of the four programs under study, suggesting that male students generally may be less certain of longer term postsecondary study and/or their career direction. The literature suggests divergent academic experiences and pathways for males begin much earlier than PSE (Kerr, 2010). Average high school grades for males in Ontario are lower than for females (King & Warren, 2006; King et al., 2009); fewer males complete high school in five years and males are less likely to complete academic courses in early high school or university level courses in later high school (King et al., 2009); males are more likely to delay PSE than females (Hango & de Broucker, 2007; Sattler, Academica Group Inc., 2010); for children immigrating to Canada, the risk of not graduating from high school is higher for males than for females (Corak, 2011); students with disabilities are more likely to be male (ACCC, 2008; Sweet et al., 2012). Within PSE, performance standards such as academic probation are less effective for male students (Lindo et al., 2010) and research offering incentives for high grades and/or additional academic support shows that male students are less likely to participate than female students, and for those males who do participate, the incentives and support have no effect (Angrist et al., 2009).

The current findings reveal that cohort males are half as likely to graduate as females and sex is significantly related to differences in academic pathway and outcome. These results support Clark’s (2007) research identifying that males lag females in making expected transitions to adulthood from the perspective of completing PSE, as well as that of Finnie et al. (2012) who suggest that not only are males underrepresented in PSE, but they are also disadvantaged regarding persistence and completion. A recently released meta-analysis of male and female school grades around the world (Voyer & Voyer, 2014) identified a consistent advantage for female students in all subject areas over the period 1914-2011.

This weight of this body of research suggests that educational opportunities at all levels, K-12 and postsecondary, are gendered. Notwithstanding the evidence that male students appear to be
disadvantaged compared to female students within educational systems, they are not generally perceived as such in the broader community and suggestions that strategies are necessary to encourage and support male students are often met with derision and scorn, given males' historically advantaged position within many societies and the persistent salary differentials for adult male workers as compared to female workers in many occupations. The pervasiveness of this negative public discourse may well influence male academic success, both directly and via cultural manifestations of that discourse internal and external to the education system.

Dietsche's (2012) survey research on Ontario college students' access of student support services shows that male students are less likely than female students to access campus services. Other research (Vogel, Wester & Larson, 2007) shows that factors which influence individuals reaching out for counseling include the perception of stigma and issues around self-esteem and social norms. Many factors are culturally specific providing an additional layer of complexity; men are less likely than women to seek support and in some cultures asking for help also goes against minority cultural values (Vogel et al., 2007). Barriers for young adults to access support for mental health issues include individual reluctance to access external resources; young adults see themselves as self-reliant and capable of self-care (Gulliver, Griffiths, & Christensen, 2010). Research (Johnson, Oliffe, Kelly, Galdas, & Ogrodniczuk, 2012) focused on male attitudes towards asking for assistance with depression reveals that self-care practices are influenced by dominant discourses on masculinity including self-reliance, strength, courage and independence (p. 350). Reframing acceptance of support as taking "responsible, independent action" (p. 351) was an important aspect to getting treatment and active therapies were preferred over passive. Demonstrating a preference for asking family members for support meant that the men "avoided brushing up against institutional structures in which power relations enacted by class, education, and ethnic differences became evident" (p. 353).
In addition to sex, age at college entry is also a significant predictor of differences in total courses enrolled and total courses passed at the $p<.05$ level in the current study; however for both sex and age the overall explanatory effect is quite small. Descriptive and analytical results demonstrate that many male students and many older students are academically successful and do persist in PSE, highlighting the role of agency (Studer et al., 2011) and the non-determinate nature of these demographic characteristics.

**Micro, Meso, and Macro Success Measures Add Value**

As previously noted, current measures to assess PSE institutional effectiveness and student success such as graduation rate and retention rate provide limited information. All courses successfully completed by students who do not graduate are disregarded, as are credentials completed by part-time students and by full-time students who do not graduate within 200% of the regular program length, and non-postsecondary credentials such as apprenticeships and one-year certificates, arguably all important parameters.

Research findings demonstrate that measures such as total courses passed and course completion rate provide information about student PSE achievement not currently recognized. Total courses passed reveals the significant academic success students achieve short of program completion which has value for the individual students, the employers who hire them and the other PSE institutions which accept some or all of these courses for transfer credit. The recent introduction of a centralized PSE transfer credit clearing house, ONTransfer.ca, for student mobility within the provincial PSE system provides indirect recognition of the value of course completion; however this is insufficient. Course completion rate provides information on student achievement relative to student aspiration.

Graduation rate as currently measured includes incidental students who have not earned a minimum number of credits (Adelman, 2000). As such, all students who are admitted to a program are
considered as equal regarding their engagement with the program of study even after some have clearly demonstrated otherwise through their academic achievement behaviour. These students are considered failures, as themselves and of the institution, rather than students who may be exploring options, interests and abilities within PSE. Adelman (2000) identified one in six students as incidental students; in this cohort, analysis suggests one in four students is an incidental student. The proportion of incidental students likely varies by program and perhaps institution. Calculating an adjusted graduation rate disaggregating information relating to students who do not achieve a minimum number of course credits in a program might increase program comparability while providing more accurate information on the composition of the student body and the dynamics underlying student achievement and institutional effectiveness.

A key limitation to the current measurement of PSE success in Ontario is that success is defined as occurring at the level of the student or the institution; not at the level of the system. Students who transfer between institutions are not tracked; something which will become possible as the Ontario Education Number, already part of the elementary and secondary systems in the province, is adopted across all PSE institutions. Results from longitudinal studies in British Columbia (Andres, 2013; Andres & Adamuti-Trache, 2008; Andres & Wyn, 2010; Lavin, 2011; Martell, 2011) underline the benefits of being able to follow students inter-institutionally and know who is not in the PSE system at any point in time.

**Academic Preparedness Matters, and Can Be Remediated**

Although the study did not directly examine the relationship between high school grades and persistence for reasons already detailed, the prevalence in the cohort of low scores in the algebra portion of the mathematics placement test and placement in remedial mathematics suggests many less-academically-prepared students enter the business diploma programs. The research findings indicate that algebra placement test score is positively related to successful course completion and
students with lower algebra placement test scores have a lower likelihood of graduating. To the extent that the algebra placement test score can be seen as related to skills acquisition in high school, the findings indirectly suggest support for Finnie et al. (2012) regarding the importance of high school grades as a predictor of postsecondary outcomes as well as Orpwood et al. (2012) regarding the relationship of secondary school pathways and final college mathematics grades. Results also suggest support for Le and Milburn (2010) regarding the relationship between mathematics placement test scores and PSE success as measured by mathematics grades and final program GPA.

Findings also support Thiessen (2008) that poor high school results are not determinate of PSE pathways; students can demonstrate agency by availing themselves of supports and be successful in PSE. While significant, the effect of a lower algebra placement test score on future academic pathways is small, suggesting a larger role for individual student agency (Studer et al., 2011) and that opportunity does exist for changing the trajectory established by prior conditions and actions.

Early High School Streaming Disadvantages Youth

Streaming of high school students into applied English and mathematics courses rather than academic courses appears to be an inequitable practice when viewed from the perspective of educational outcomes. Ontario longitudinal research (Shulman & Kozlow, 2014a, 2014b) demonstrates a link between enrolment in these courses in grade 9 with performance on provincial standard exams in elementary and early secondary school. Within high schools, support for early streaming into applied courses is perceived as support for multiple and diverse pathways in PSE and as a counterweight to the pro-university bias that many parents have, including for students who are struggling academically (People for Education, 2013, 2014); however, Ontario students who enrol in applied courses in grades 9 and 10 are subsequently restricted to college level courses in grades 11 and 12 limiting their future initial PSE pathway to college, as bridging opportunities are limited.
(Orpwood et al., 2012). Revisions have been made to high school mathematics curricula since 2006; however, research indicates that patterns of achievement for college students who took applied courses in grades 9 and 10 have not significantly changed (Orpwood et al., 2012); the evidence also indicates that the number of students placed in college level remedial or foundational mathematics courses in first term has increased significantly since 2008 (The College Student Achievement Project Team, 2014). It has previously been noted that findings from the current study regarding high school course streams may be unreliable; notwithstanding this caveat, results suggest that enrolment in non-academic and/or non-university English and mathematics courses in high school may be related to individual academic outcomes and pathways in college.

College entry mathematics placement test scores reflect performance in mathematics curriculum from the late elementary-early secondary years (Orpwood et al., 2012). Research by People for Education (2014) confirms that students (and parents) choose between applied and academic courses during the winter prior to entry into grade 9 when students are age 13-14. This arguably premature and short-term decision is often made largely on the basis of elementary school grades and performance on grade 6 provincial assessments while affecting opportunities for PSE four to five years in the future.

Early streaming is less inclusive and more inequitable particularly for students of disadvantaged backgrounds. Recent research (People for Education, 2013) shows that schools, generally in Ontario and specifically in the GTA, which have the highest level of applied mathematics enrolment in grade 9 also have higher scores on measures related to disadvantage including lower family income, fewer parents with university education, higher levels of poverty, more parents without secondary school completion, a higher proportion of recent immigrants and a higher proportion of ESL and Aboriginal students.
Enhanced Pre-Entry and Early Advising May Be Of Benefit

Research findings highlight several key aspects of student behaviour which appear to indicate students who might benefit from additional advising support. Students who applied by July 1st for the September entry were 1.6 times as likely to graduate compared to students who applied later. Late application to PSE may indicate academic or career uncertainty coupled with a lack of familiarity with the PSE system, processes, and timelines, or personal commitments or resource constraints which interfere with planning, and negatively affect student academic outcomes. Pre-entry advising for late applicants in particular could be instituted as a requirement of admission to identify the context of the late application and what services, if any, might be beneficial to support the student's success.

Boxplot results of course completion rate by graduate and higher credential suggest that few students with course completion rates below 50% persist at that completion rate level to graduation, an indicator which may be useful in practice to identify students early on who might benefit from support and guidance including regarding career path, program of enrolment, and/or course load. Transition rates between enrolment-achievement states suggest that both positive and negative academic pathways are self-reinforcing and once a student fails to re-enrol as expected for a term, the probability of re-enrolling decreases. Tracking of the term-by-term enrolment-achievement alignment by individual student might also assist with identification of students who could benefit from additional support.

Cohort students display a tendency to migrate to the shorter and less structured general business diploma programs, support for the argument that these programs attract students who are more uncertain of their career path or who require more flexible study options. One out of eight cohort students eventually transferred to a completely different program once enrolled at Humber suggesting that the general business programs may be perceived as a default, safe choice by students who lack knowledge of alternatives or self-knowledge of strengths and interests. This suggests there may be
an opportunity for early, ongoing, and exit student advising for students in these programs, particularly as more than 15% of cohort students left both the program and the college after one or two terms of study and many students who do end up in a non-business program as their final program of enrolment take a longer term path to get there. The high proportion of students who transfer to non-business programs in the college also suggests that the process of engagement with a PSE program over time may support student development of clearer goals and self-recognition of strengths and interests.

**Prior PSE Credits Signal Success, Not Failure**

Based on the low number of transfer credits received by individual students in the fall 2006 cohort, it can be inferred that students with one or more transfer credits for prior PSE study had not completed a PSE program prior to entering Humber. These students are therefore considered drop-outs from the institutions of prior enrolment. Analytical results from the current study suggest however, that entering a program with course credits from prior successful completion of PSE appears to be a significant and positive predictor of differences in academic pathway and outcomes; students with transfer credits were 2.5 times as likely to graduate compared to students without. Although the overall explanatory effect is small, this highlights the inaccuracy in identifying students who leave an institution prior to program completion as failures and institutions with students leaving as not fulfilling their mandate. It also supports the argument that the value of courses completed should be formally recognized at the individual, institutional and systems levels, not only indirectly through the mechanism of transfer credits at the individual student level.

**Institutional Structures May Affect Student Pathways and Persistence**

None of the descriptive or analytical research findings identifies specific institutional barriers to student achievement or persistence; however the pathways and patterns of enrolment and
achievement do suggest that certain system and institutional structures and processes may affect pathways, with negative implications for outcomes. For example, mathematics placement decisions are based on the total mathematics placement test score whereas research results indicate it is the algebra score which is related to the academic outcome. The college does not use the algebra score alone for placement. Doing so would likely result in more students being placed in the pre-curriculum remedial mathematics course, for which the college receives no government funding; a perverse situation as arguably the student scores reflect a failure of the publicly funded K-12 education system at a time when the expectation is most, if not all, high school graduates will complete PSE. Via additional tuition and opportunity costs borne by students at the PSE level, the effect is to privatize the achievement cost of some of the K-12 learning outcomes; often for students who are least able to bear this cost. This gives rise to an important policy issue. As most, if not all, high school graduates today are expected and encouraged to further their education, it suggests that the government has a responsibility to ensure that graduates of the public K-12 system have the necessary mathematics and literacy skills to be successful in PSE.

The full-time, part-time enrolment distinction is problematic due to how it relates to the structure of institutional funding, the delivery of programs, and the measurement of outcomes. Institutional structures, systems and processes are aligned with traditional daytime, full-time course delivery in fall and winter and likely negatively affect academic achievement for some students who reduce their course load to part-time so as to manage multiple personal demands and roles.

Student academic outcomes and pathways reveal that many students enrol in more courses than they are able to successfully complete in a term; the majority of students in the study have course completion rates lower than 80% and sequence pathways reveal the prevalence of this discrepancy. Curriculum design, flat rate tuition fees, government funding parameters for institutions, and government student loan eligibility rules directly and indirectly encourage students to make this
decision, often for multiple terms of enrolment, with significant private cost. Historically, full-time and part-time students were seen as distinguishable groups based on more than enrolment status. Part-time students were older, employed full-time and available to take one or two courses in the evening in a term. Full-time students were younger and did not have significant external commitments, so were expected to enrol in a full course load and attend daytime classes. Government funding and institutional practices continue to differentiate enrolment as either-or although the research findings suggest that many students who initially enter the program full-time with a course load of six courses will adjust their course load term-by-term to balance multiple demands on their time. Students who avail themselves of this flexibility appear indistinguishable from those who do not regardless of how many courses they are taking.

As previously noted, students who are categorized as part-time are excluded from program completion measures. Part-time students also face challenges as a result of differentiated institutional structures, policies, and processes and differentiated access to supports. Part-time students have restricted access to student loans; they also have no, or limited and delayed, access to daytime classes. Evening and online courses are managed by separate organizational units and are taught by part-time and partial load contract faculty, many of whom are less committed and engaged with the institution compared to full-time faculty who are restricted to teaching daytime courses by the terms of the academic collective agreement. Student support services are not open in the evening.

The flexibility provided to students to continue a program on a full or part-time basis and to enrol in daytime, evening, and/or online courses for three terms each year provides access to PSE for students who are unable or unwilling to attend according to a more traditional schedule. The challenge is that this flexible structure may also encourage students to prioritize activities other than PSE, impeding persistence and/or completion. As well, many programs of study do not offer this
flexibility and therefore students who have substantial commitments outside of academics may choose programs for scheduling reasons rather than for interest.

These college structures or other processes do not appear to be designed primarily to cool out (Clarke, 1960) student PSE and career aspirations. The mission and culture of Humber continues to be providing access for students and career and credential pathways, and faculty, administrators and staff are committed to supporting students to achieve their goals. Although none of the four business diploma programs in this study are terminal programs (they all provide pathways to degree level study at Humber and at various universities), it is possible that policies and processes do in fact divert some students from their initial career paths into a terminal program (Brint & Karabel, 1989), a question for future research.

**Significance of the Research**

The significance of a research study is determined by whether it contributes to or extends previous research in a given area. This study extends the literature on postsecondary student success in three ways: it provides a detailed longitudinal mapping of individualized education pathways within one institution beyond the expected time frame for graduation; it tracks a range of academic achievement measures other than graduation rate, including total courses enrolled, total courses passed, course completion rate, and graduation beyond the policy mandated graduation deadline; it explores relationships between academic achievement measures and academic pathways, and student demographic characteristics, prior academic characteristics, and student behavioural and academic characteristics related to the student-college interaction at the time of entry.

The findings of the research also support Finnie et al. (2012) that student group level identification as a predictor of pathway and/or persistence is of limited use. Most of the student group level characteristics explored in this study differ from those analyzed by Finnie et al. (2012), nonetheless,
the conclusion is similar; once in PSE, differences do not appear to exist in pathways and/or persistence at a level which justifies group level funding for specific initiatives which are by design not accessible to other students who might benefit from the additional supports.

The results of this study challenge aspects of the theoretical frameworks of Tinto (1975, 1993) and Bean (1980), Bean & Metzner (1985) and Metzner and Bean (1987) which underpin much of the research on PSE student success. The research findings also suggest aspects of the current institutional and system structure may be inequitable as they differentially affect some students more than others, particularly those students who may not be able to participate in PSE in the traditional manner.

Equally important, the findings of this research study suggest that more attention needs to be paid to the success stories: the many students who persist and succeed despite having one or more characteristics which the literature and the system suggest identify them as at risk of failure.

**Recommendations for Policy and Practice**

As an exploratory study into the academic pathways and outcomes for one cohort of students at one college, findings are not generalizable to other populations. To the extent that recommendations and conclusions can be drawn, they relate to practice and policy at Humber with regard to these programs specifically, and to educational policy as it relates to prior academic trajectories experienced by cohort students; although it is possible these recommendations may be considered to have applicability to other student groups and/or other institutions or to educational policy more generally.

**Focus on Individual Student Academic Goals and Achievement**

A unique finding by this study is that student group membership appears to be insufficient to differentiate individual students by academic pathway or outcome at the institutional level; extending
provincial level research (Finnie et al., 2012). Based on my academic advising experience, many students identified within the institution as being a member of a group at risk of failure, succeed academically; many others not so identified, do not. The identification of students by group level characteristic by the college confines how students are seen by others and does not adequately define who they are, what their goals are, what supports might assist them in achieving their goals, or what barriers they might encounter. Students want and need to be seen as individuals.

Institutional resources should be devoted to early, ongoing, and exit individualized advising for students with disintegrating or disappearing academic pathways, with targeted support for students who apply later to a program. A team-based approach to advising and student support should be encouraged, with in-service training for full and part-time faculty and the adoption of ongoing program–related communities of practice. Consideration could also be given to end-of-term program level progression reviews before grades are finalized for faculty to share experience and knowledge of individual students.

Identifying individualized needs and supports may mean revisiting the part-time/full-time dichotomy and how that impacts the resources accessible to students, as well as where programs and courses are housed and delivered and how student support is structured, delivered and accessed. Ontario research (Seifert, Arnold, Burrow, & Brown, 2011) on student services within diverse colleges and universities found that staff members are less likely to perceive their institution as student-centred when organizational structure and culture are characterized as siloed across different units, common in a large organization such as Humber. Institutions must also examine the messaging around accessing academic and other supports in light of the differences in how male and female students and students of different cultures, including minority cultures, perceive needing or asking for help.
Relationships Matter

An increased focus on individual student goals, strengths, needs and challenges can be achieved in different ways. Relationships are recognized as the basis of positive learning environments (Pascarella & Terenzini, 2005). Mixed method longitudinal research (Chambliss & Takacs, 2014) at one small liberal arts college in the United States found that the most important factor in student success was a close relationship with a faculty member during the student's time at the institution. Although the research context is quite different from that of the current study, intuitively it makes sense that individuals within a developmental and learning context such as college find value in key interpersonal relationships with leaders of the community. In May 2014, at the end-of-year retreat for academic leaders at Humber, high achieving student presenters showcasing their work consistently credited relationships with specific faculty members as crucial support for their achievements.

Research supports the positive effect transformational leaders have on followers, including in a postsecondary classroom context (Bolkan & Goodboy, 2009, 2011; Pounder, 2009; Walumbwa, Wu & Ojode, 2004) where professors have positively supported student success by demonstrating characteristics of "idealized influence (encouraging and motivating students), inspirational motivation (elevating students' expectations), intellectual stimulation (encouraging students' imagination), and individualized consideration (valuing students' needs)" (Walumbwa et al., 2004, p. 126).

If it is considered desirable to increase the potential for these types of relationships to occur (something which may be difficult in an era of universal PSE), the college must allocate resources, and design space, systems and processes toward this goal. Current structure should be reviewed from the perspective of what kind of relationship with each student does it support and encourage? In the past decade, PSE institutions have invested heavily in student services programs and personnel and less so on full-time faculty in the classroom where commuter students spend most of their time on campus. Many student services programs are primarily focussed on social integration,
designed to foster social engagement outside of class and to support students identified by group membership, for example, Aboriginal students, Mature Students, International Students, 1st Generation Students, and First Year students. Academic integration occurs primarily in the academic space of the institution, which is arguably where the institution-student relationship is to be fostered.

At Risk Discourse is Detrimental to Student Success

The conceptualization of students at risk permeates the PSE student success literature and PSE institutions, including Humber. It is used to identify, categorize, and label students, members of certain demographic or socioeconomic groups, who might experience differentiated patterns of academic achievement relative to normative patterns; a practice identified as pathologizing. Shields, Bishop and Mazawi (2005) define pathologizing the lived experiences of others as

[a] process where perceived structural-functional, cultural, or epistemological deviation from an assumed normal state is ascribed to another group as a product of power relationships, whereby the less powerful group is deemed to be abnormal in some way. Pathologizing is a mode of colonization used to govern, regulate, manage, marginalize, or minoritize, primarily through hegemonic discourses. (p. x)

It is beyond the scope of this study to examine the reproduction of social hierarchies through the structure and discourse of the Ontario K-12 and postsecondary educational systems. Suffice it to say that the structure and composition of PSE in Ontario and Humber’s community serves to perpetuate the historical hierarchy of college as less valuable than university, negatively reflecting on the students in the institution. Students arrive at the college, many having already internalized the message from parents, guidance counsellors and peers that college is less valued than university. The majority of full-time and part-time faculty at the college have at least one, if not two or three, university degrees. A college diploma is insufficient to teach in the ITALs, and, as degree programming increases, the minimum credential required to teach is quickly moving to a terminal
degree in the subject of specialty. With these credentials comes a certain worldview on what counts as knowledge and what represents success.

The conceptualization and language of risk in education begins at or before kindergarten, and permeates all levels of the system, generally with negative connotations regarding developmental or other outcomes (Canadian Education Statistics Council, 2001), and including an assumption of prediction (Schonert-Reichl, 2001). It is used for example, by the Ontario Education Quality and Accountability Office in categorizing kindergarten students’ development as vulnerable, at risk, ready and very ready (Shulman & Kozlow, 2014a, p. 1; 2014b, p. 2). At the postsecondary level identifying and labelling students as being at risk reflects assumptions about individual student PSE goals, the limited student success measures within the PSE system and the perceived relationship of student deficits to student group membership, problematizing who the students are, identifying them as inadequate and in need of intervention, and disavowing student agency. Limited student success measures constrain the options that students see as available to them and the identification and discussion of individualized goals. Labelling students as at risk based on whether they do or do not progress through PSE as expected by the system, pathologizes the student experience and stigmatizes those students whose pathways and outcomes do not fit within the constructed normality of traditional PSE pathways and outcomes, while creating barriers to their success. At risk places responsibility for outcomes at the level of the individual and his or her personal characteristics or circumstances, absolving institutions and systems of any role or responsibility. By implication, the academic trajectory of a student who is at risk of failure is predetermined without external intervention rather than malleable by student initiative or affected by institutional structure and policy.

The college offers many supports for students who are not successful by traditional measures; these are accompanied by complaints that few students avail themselves of the supports. A common refrain is the students who are most at risk of failing, do not ask for help. Perhaps this should not
come as a surprise. As noted by Wotherspoon and Schissel (2001) "a dominant tendency exists in many associated educational interventions to adopt a medical or pathological orientation that continues to focus negatively on students who are considered to constitute parts of a problem population" (p.323), including populations identified by cultural, demographic and socio-economic characteristics.

At risk discourse is harmful to student self-identification as able, resilient, persistent, and capable, while narrowing the perception of students by faculty and support staff. Behaviour which is interpreted by the system as dysfunctional may be indicative of a challenge where a student could use support; it may also be indicative of strategic decision making and allocation of scarce resources by the student. It might equally signal inequitable structures, policies and processes within the institution or system which reduce access for some students. At risk language prevents contextual exploration of unjust social conditions or rigid institutional structures (Wotherspoon & Schissel, 2001).

**Review Flat Fee Tuition Structure for High Access Programs**

The general business diploma programs are high access programs, representing second chances at accessing PSE with pathways to both college and university degree level studies for many students. Beginning in 2015, Ontario universities are required to permit students who are taking less than a full course load to pay tuition calculated by course credit rather than through a flat fee as is currently the practice at Humber and the other colleges. This tuition structure should be considered at the college level as well, particularly for high access programs where it is clear that many students struggle to complete the program as structured. Individual students would save money and/or incur less debt if they were permitted to pay for a lower course load without being restricted to evening and online courses. Paying by course would also remove the current incentive for students to take the maximum number of courses, perhaps encouraging students to enrol in the only number of courses they are capable of completing successfully each term.
Evaluate Modular and Compressed Course Delivery, and Curriculum Structure

In recognition that many students are unable to commit to an organized PSE structure over consecutive terms and years, consideration should be given to modularizing some courses and/or offering shorter, more intensive course delivery options for key courses which students have difficulty completing in a regular fifteen week term while taking additional courses as well.

Consideration should also be given to whether students have too much flexibility regarding what courses to enrol in each term, and the number of times they may re-enrol in a course after dropping or failing it. Students easily get off track as they drop and avoid courses which build on areas they are not strong in, for example mathematics or English. This lengthens the students’ time to completion and enables them to delay mastery of critical skills.

Collaborate with K-12 Educators on Pre-PSE Curriculum and Skill Development

Humber must continue to collaborate with K-12 educators and responsible provincial government bodies regarding the curriculum and skills necessary for high school graduates to be successful in PSE, particularly in English and mathematics.

Revisit Early High School Streaming; Emphasize Options

Although more research is needed on the relationship of high school mathematics and English course streams to PSE pathways and outcomes, other research (People for Education, 2013, 2014) does suggest that early streaming into applied courses in grade 9 and college courses in grades 11-12 limits the postsecondary options of many students, particularly those with disadvantaged backgrounds. The timing of streaming should be revisited with consideration given to postponing all streaming until late high school, coupled with intensive support for students as necessary for mastery of the required knowledge and skills to that point. Measures of student success should also include
language and metrics referencing the full range of possible careers including vocational options in the trades. Serious consideration should be given to re-introducing applied trades courses as part of the required course structure for all students in early high school and the elective course structure in later years in all schools.

**Review and Align Provincial and Institutional Resource Allocation**

Decisions regarding allocation of resources for student support at both the provincial and the institutional levels should not be made on the basis of demographics or otherwise identified student groups, as student groups are not uniform in need. Funding and programs to support students who face challenges in navigating and negotiating PSE institutional and academic expectations and achieving their personal goals should be designed to prioritize and facilitate identification and advising of individual students based on each student's goals, progression and challenges.

Provincial resources must continue to encourage greater transferability between colleges and universities through mechanisms such as the funding of college-university partnerships, for example, Guelph-Humber University. The Ontario Council on Articulation and Transfer, established in 2011, is designed to facilitate inter-institutional transfer for students through its website ONTransfer.ca; however, the system is quite new and significant barriers still exist at institutional levels.

**Conclusion and Directions for Further Research**

This research study explored and mapped the individual PSE student academic outcomes and pathways for one cohort of general business diploma students in one Ontario college and evaluated relationships between outcomes and pathways with individual student demographic, prior academic, and college entry characteristics, within the limitations of the historical institutional administrative data available. The study contributes a unique perspective on the individual academic outcomes and pathways of postsecondary students. The findings challenge the major student success frameworks
foundational to decades of postsecondary student success research, as well as a number of the student success assumptions, language and the policy structures in PSE today, by highlighting the heterogeneity of students identified by group level characteristic at the institutional level. By also extending work on PSE pathways at the secondary level, this study contributes to bridging the gap between research at the school board and provincial levels.

The research identified several independent variables with significant relationships with academic outcomes and the dissimilarities between sequence trajectories; however, causality cannot be inferred from these relationships as other explanations based on variables not studied cannot be excluded. Findings suggest a number of areas for further research.

First, replication of the research design with other cohorts of these and other programs within Humber might permit broader generalization of some of the research findings. The fall 2006 cohort entered Humber more than 8 years ago; data on more recent cohorts might identify different patterns and relationships. Replication with similar program cohorts from a similar era in other institutions in Ontario might identify generational factors while replication with similar program cohorts from institutions in other provinces with differently structured PSE systems might support exploration of systems level factors.

Another area of inquiry which shows promise is qualitative or mixed methods research into individual student academic outcomes and pathways from the student perspective including regarding student goals, motivation, career certainty, PSE and program goal commitment, and system, institutional and program structures constituting supports or barriers to success, including the effect of the prevailing at risk discourse and labelling of students.

Findings of this study regarding prior trajectories suggest there is considerable value in further exploration of relationships between PSE pathways and diverse academic outcome measures with
high school mathematics and English grades, course stream and content, with particular emphasis on the college stream courses which students expect, perhaps with good reason, prepare them for successful college level study.

Additional directions for further research include employing the Ontario Education Number to explore student pathways through the K-12 system and subsequent transitions into PSE and the work force for diverse students.

Finnie et al. (2012) suggest that institutional data could be useful in identifying students who require support, based on their high school and postsecondary academic records, together with direct measures of their PSE experience through the use of surveys. Research on the “data-readiness” of five Canadian colleges and universities (Social Research and Demonstration Corporation, 2009, p.3) to support student retention highlighted institutional concerns which could influence the success of such an initiative. These include the accuracy and reliability of the student group level demographic data collected, low student survey participation rates, issues around student privacy, and the possibility of student alienation as a result of the institution asking intrusive questions at the time of entry. Institutional structural challenges were also identified as problematic, including a lack of institutional resource capacity to collect, process, and analyze institutional data.

Institutional data are currently inadequate to track PSE student success from the perspective of student success literature and historical theoretical frameworks focused on group level characteristics. Agreed upon definitions for demographic categories such as first generation, Aboriginal, Black do not exist, and research (Oldfield & Ungerleider, 2010) suggests that students may not identify with defined categories and are often reluctant to self-disclose. Detailed demographic data may be held by public school boards; for example, the TDSB collects extensive student and family survey data in an annual census utilized in post-high school pathway research (see Sweet et al., 2010). With the recent adoption of the Ontario Education Number by PSE
institutions, it is possible this data could be matched with postsecondary level data, an avenue which may hold promise. However, based on Finnie et al. (2012) and as suggested by the findings on pathways and outcomes in this study, such a data initiative might be of limited benefit given the heterogeneity of student groups and the evidence that prior trajectories do not determine future pathways.

The results of this study confirm the challenges of relying on institutional data. While conducting this study, I encountered difficulties related to technological change, institutional growth, data reliability, how data are collected and recorded, and institutional resource limitations. Institutional capacity at Humber to perform large scale data analysis does not currently exist. The Office of Strategic Planning and Institutional Research is responsible for supporting the measurement of institutional outcomes to meet external reporting requirements, including program and school level success and retention measures related to KPIs. Reports of the type required for detailed analysis at the student level must be requested ad hoc by program administrators and coordinators, most of whom do not have the time or the knowledge and skills for analysis and interpretation beyond the descriptive level. Relevant data, when available, are often not accessible or in the format required for analysis. It remains to be seen whether this will change once the college has completely transitioned to a new ERP system by fall 2015 and adopts a strategic enrollment management framework over the next several years, particularly given ongoing government funding constraints. Even with the new system, the decision has been made to limit the number of years of detailed historical data from the legacy systems to be saved and/or transferred into the new system. Without sufficient accessible historical data, exploratory longitudinal research such as demonstrated here will not be possible for some time.

Notwithstanding the identified challenges, this study illustrates the value of institutional data on its own and linked with high school student level data provided as part of the application process which bridges the institutional and systems divide between secondary school and PSE. A robust and well
considered data collection initiative combined with institutional analytic and interpretation capacity might position Humber to better provide individualized support to students. For example, exploration of student behaviour at the individual course level might reveal structural issues embedded in program curriculum related to course and content sequencing not currently apparent.

There are critical parameters which must be considered in determining what data to collect and with what methodology, and how and where in the organization the data will be analyzed, interpreted, communicated and acted upon. To illustrate, student diversity occurs on numerous levels and involves varied cultural factors including religion, citizenship, immigrant generation, language, political ideology, age at immigration, personality, motivation, sexual orientation, ability, and race (James, 2003). A data collection and analysis initiative relying on such detailed student level personal information would likely be perceived as intrusive and implicitly supportive of the concept of student groups at risk.

Big data in organizations of all types and sizes is a global strategic focus, including for PSE institutions. Data collection initiatives with algorithmic learning analytics to efficiently identify and target students at risk, as envisioned by some institutions with strategic enrolment management systems, require that student activity, including student-faculty interactions, be recorded and collected electronically. However, electronic "student performance monitoring" (Picciano, 2012, p.13) intermediates the relationship between individual students and faculty members and likely reduces the possibility for interpersonal relationships which have the potential for transformational moments, and increases the possibility of negative communications experiences. Electronic warnings based on frequency and type of student interaction with the learning management system are delivered regardless of individual personal circumstance and have the potential to do as much harm as good. Without talking to individual students and asking the relevant questions, it is impossible to disaggregate structural factors from individual factors, and risks placing the responsibility for
challenges on the student rather than systems and/or institutional structures, processes, or policies where it might more likely belong.

Any data initiative for PSE student support must carefully consider what data are relevant and include both quantitative and qualitative data in the form of the students’ stories and narratives so that the complexity of the student-institutional-system context can be incorporated. Privacy issues must also be situated first and foremost.

My role at Humber has changed since I began this research. I am fortunate that I am now in a position of leadership with responsibility for five access diploma programs in the accounting and law areas with approximately 1800 enrolled students and 70 full and part-time teaching faculty. As an Associate Dean, I must balance institutional requirements for policies and practices which support the value of our credentials in the marketplace and efficient use of resources in program delivery, with the needs of individual students in managing the multiple and varied responsibilities they have in addition to their academic studies. As a member of the school administrative team and part of the college academic operations administration I have the opportunity to ask questions, raise issues, and perhaps influence policy regarding the challenges identified above. With regard to my program portfolio, I have the ability and the responsibility to more directly influence policy and procedures which affect students inequitably. My next research project will ideally be to build on the findings of this study with both quantitative and qualitative exploration of student academic achievement outcomes and pathways incorporating students’ perspectives on influences and barriers.
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